FACULDADE DE CIÊNCIAS SOCIAIS E HUMANAS
UNIVERSIDADE NOVA DE LISBOA

Developing Young Learners' Logical/Deductive Thinking Skills and Second Language Skills through a CLIL approach

Denise Maria de Figueiredo Alvarenga

Trabalho de Projeto
em
Didática do Inglês

Setembro 2012

Trabalho de Projecto apresentado para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Teaching English as a Second / Foreign Language realizado sob a orientação científica de Allyson Roberts and Ana Frankenberg-Garcia

Dedicated

to my parents who have always encouraged me to push forward and never give up

ACKNOWLEDGEMENTS

I would like to express my sincere thank you to my family and boyfriend for all their support shown during this voyage, Sofia who was my companion in this crusade and Sónia who was always available to help and encourage me.

I would also like to express my gratitude to Allyson Roberts and Ana Frankenberg-Garcia for their endless support, patience and, most important, guidance.

Finally, I would like to thank my school and my students without whom this project would not be possible.

DEVELOPING YOUNG LEARNERS' LOGICAL/DEDUCTIVE THINKING SKILLS AND SECOND LANGUAGE SKILLS THROUGH A CLIL APPROACH

DENISE ALVARENGA

ABSTRACT

This project work seeks to explore the numerous benefits of introducing a CLIL approach within the ELT classroom, simultaneously evaluating the possibility of improving mathematical skills and developing second language skills through a CLIL approach with young learners aged nine and ten. This action research project aims, thus, to provide an answer to the research question *Can young learners improve both their Mathematical thinking skills and second language skills through a CLIL Approach?*

This action research was developed using a CLIL approach and took place in a private primary school, involving a group of 18 young learners attending the fourth grade, who enrolled in an English Club, which took place once a week for half an hour. Young learners participated in groups of three or four in five teaching cycles, with increasing levels of difficulty, where they were asked to complete a problem solving task within a task cycle designed in accordance with a Task-Based Learning approach.

Taking into account the findings of this research, it was possible to conclude that young learners were able to combine English as a means of communication and the language of mathematics in order to perform problem-solving activities which aimed to help learners progress in skills regarding a second language and mathematical reasoning.

Keywords: CLIL, Maths, English Language Teaching, TBL, Logic and Deduction, Critical Thinking, Young Learners

RESUMO

Este trabalho de projeto procura explorar os enúmeros benefícios do uso de uma abordagem CLIL no ensino da língua inglesa como língua estrangeira e simultaneamente avaliar a possibilidade de melhorar competências matemáticas e competências associadas a uma língua estrageira através de uma abordagem CLIL, com crianças do 1º ciclo do Ensino Básico. Este action research tem como objetivo responder à pergunta *É possivel melhorar competências matemáticas e competências associadas a uma língua estrangeiraatravés de uma abordagem CLIL?*

Este action research foi estruturado usando uma abordagem CLIL e desenvolveu-se numa escola privada, envolvendo um grupo de 18 crianças que frequentavam o 4º ano de escolaridade. Estas crianças inscreveram-se no English Club que tinha lugar uma vez por semana durante meia hora. As crianças participantes neste projecto trabalhavam em grupos tendo participado em cinco ciclos de trabalho com diferentes níveis de dificuldade, onde tiveram de completar atividades matemáticas que envolviam problemas matemáticos de lógica e dedução. Estes cinco ciclos de trabalho foram desenvolvidos usando uma abordagem Task-Based Learning.

Tendo em conta toda a informação recolhida neste projeto, é possible concluir que as crianças foram capazes de combinar a língua inglesa como meio de comunicação e a linguagem matemática na resolução de todas as actividades proposta. Todas estas actividades matemáticas tinham como principal objetivo que as crianças deste projeto progredissem no desenvolvimento das competências matemáticas ligadas à logica e à dedução e que também desenvolvessem competências associadas à aquisição do inglês como língua estrangeira.

Palavras chave: CLIL, Matemática, English Language Teaching, TBL, Lógica e Dedução, Pensamento Critico, 1º ciclo

TABLE OF CONTENTS

Introduction

The educational context is currently experiencing significant changes within second language learning and teaching. Globalization phenomena have set new objectives as far as curriculum building is concerned, and educators challenge themselves in order to meet learners' needs regarding the natural evolution in education systems.

This may be the result of living in a multicultural and plurilingual world, where learning a second language is no longer just the simple act of developing competences for writing, reading and comprehending in that language. In order to provide better opportunities for learners' professional development, educational systems have combined content and language so as to equip learners with tools that will help them and support their professional choices in the future.

Many subjects have been intertwined with a second language such as Science, Social Studies, Arts, Music and Mathematics. For this project, the main concern involved the development and improvement of mathematical reasoning in a second language context with young learners. Nowadays, the development of critical thinking skills and mathematical reasoning is stepping outside the L1 comfort zone and has been taking a more active role when explored alongside a second language, such as English. Some studies have been conducted regarding Mathematics and English involving secondary and university students, but very few consider such abstract and conceptual content with a second language with young learners, namely primary students.

This project emerged from the research question *Can young learners improve both their Mathematical thinking skills and second language skills through a CLIL Approach?* The main aim was to explore and investigate the implications of this question by the means of creating a project work that would, through a series of teaching cycles within a content and language integrated learning approach, improve both young learners' mathematical thinking skills regarding logic and deductive competences and second language skills.

In order to find the answer to this research question, a literature research and an action research were developed to collect data. This project work is divided into five

main parts. Part I introduces the context of the study, including the school and the young learners who participated in this project which allowed this project work to take place. Part II embodies the literature review that explores the core elements regarding the research question: content and language integrated learning; critical thinking skills linked to logic and deductive thinking and their influence on the development of mathematical reasoning; task-based learning and teaching as a framework that helped organise the action research; group work skills and their role on content and language learning, and assessment as an ongoing essential part of the teaching and learning process. Part III describes the research component in this project work, presenting the origins of this project and the research methodology applied for the action research and the data collection. Part IV explores the process of attempting to improve young learners' mathematical reasoning regarding logic and deduction and language improvement through a CLIL approach within a small action research cycle. In Part V, all the data collected is analysed and interpreted, and the implications of the findings are presented. To finalise this project, Part VI presents the conclusions and recommendations that emerged throughout this project.

As this project work was developed within an action research cycle, I was able to understand whether young learners were able to improve both their language and mathematical reasoning skills through a CLIL approach. It became clear that it is possible to guide learners through a series of teaching and learning cycles which will help them improve, not only their second language learning process, but also their critical thinking skills of interpretation; analysis; inference; evaluation; explanation; and self-regulation which will help improve young learners' mathematical reasoning.

Part I – Context of the Project

1. Context

1.1 The School

This project took place in a Portuguese private institution which is both a kindergarten and primary school. In this school, English plays large part in students' academic life. In kindergarten, young learners of 3 to 5 years old have a total of fifteen hours a week of English, three hours per day. The exposure to English at this stage is focused on songs, stories and vocabulary games. In addition, the English teacher accompanies the group in its daily routines: lunch time, toilet break and recess, which allows learners to be naturally exposed to English language in authentic use.

By the time learners reach primary level, their English lessons are reduced to seven and half hours a week, one and a half hours per day, due to the weighting of the Portuguese curriculum. At this point, young learners start having a more formal exposure to English. Learners are still exposed to day-to-day spoken English, but they begin to learn to read and write in English and the focus on the English language teaching changes – its focal point becomes, then, reading and comprehension; writing and spoken interaction and production, not just listening and comprehension. From the first to the fourth year, learners work with course books and are engaged in Cambridge exams at the end of the second, third and fourth years – Starters, Movers and Flyers, respectively. By the time they complete the fourth year, they have comfortably reached the A2 level of the Common European Framework of Reference.

1.2. The School's History

The school in question is a kindergarten and primary school. It was founded on 3rd November, 1935, with only six students, now having more than three hundred kindergarten and primary young learners. From the moment of its opening, the founder aimed to foster at this school ideals of intercultural awareness and also specific principles involving English language teaching and learning. She believed that English

should not be seen nor taught as a mere extra curriculum activity. The founder strongly believed that English should be taught "much like the mother tongue through continual exposure and individual learning based on the development of aural/oral skills" [1]. That is why English has an important role in this private school curriculum and therefore plays an important part in the learners daily schedule.

1.3. Students involved in the Project – The English Club

1.3.1 The Group

A few years ago, and with the emergence of new approaches that work towards an innovative development of English language teaching, this private school began to implement CLIL as a new methodology in English language teaching through subjects that would interest students, namely Science and Social Studies. To help implement this approach, an English club was created, which engaged young learners in varied and interesting activities where the English language was the effective means of communication.

In the beginning, only fourth year students were advised to participate in this club. However, nowadays, third year learners may also enrol in this after-school activity. Since young learners who attend this school have a great amount of exposure to English, older students feel very comfortable using the English language to communicate and have a good level of understanding in this foreign language. For that reason, the English club was an immediate success within this educational context and is still an ongoing project.

Since this Project Work is based on a small action research, it would be essential to put this Project into practice. Embracing the already existing after-school clubs and engaging in this school's trend to integrate innovative approaches to English language teaching, it made complete sense to take the implementation of CLIL to the mathematical field of logic and deduction, thus pursuing the improvement of critical thinking skills among students who had already acquired critical and mathematical

[1] From the schools homepage online at < http://www.qes.pt/> [accessed on 17 February 2011]

thinking skills that derived from their progress in Mathematics' curriculum for primary levels.

The main aim of this Project was to explore whether it was possible to simultaneously improve young learners' mathematical reasoning and second language skills through a CLIL approach. Naturally, to carry out this research, I needed to create a specific time and place to put it into practice, to collect data and to conduct research in the development of logical and deductive thinking skills. So, with the approval of the school's headmistress, an English club was created for this purpose.

1.3.2 The English Club

As mentioned before, the school's English language teaching dynamics already included an English Club that aimed to integrate CLIL, mainly focusing on Social Studies, History and Citizenship.

Another co-worker and I decided to develop an English club once a week that was to take place within the already existing English Club – the Monday Club. This workshop took place once a week for 60 minutes, divided into two blocks of 30 minutes. In each block there were 9 to 10 students organised in groups of 3 or 4 members. The same groups were consistently maintained so we could observe more carefully their evolution; if we changed groups constantly, it would be extremely difficult to keep track of their progress, and it was also very likely that students would probably change their behaviour according to the members of each group. We also organised the groups ourselves so that we would not have unbalanced groups. As we knew most of the students who had enrolled in the Monday Club, along with their teachers, we organised each group according to several characteristics so the groups could be as homogenous as possible. Furthermore, we took into consideration for the organization of the groups specific learners' traits, such as:

- personality traits;
- learning ability;
- English level;

- Level of Critical thinking skills development.

According to Furnham (2005:20), "if traits of personality variables are carefully selected (to be relevant) and measured, they can indeed be powerful predictors of individual and group organizational behaviour". In this sense, we felt it would be beneficial for learners and the research itself if we had balanced groups regarding both language and mathematical knowledge. In addition, as Furnham (2005) has stated, each individual, whether a child or a grown man, changes their behaviour according to each situation, which was something we wanted to avoid, so that improvement could be consistently measured and variables of such improvement could be stable throughout the Project.

Having created the space and the conditions for the small action research embedded in this project, it was then necessary for it to be developed to understand how to combine content and language in a 30 minutes, once a week English club. Taking into account the research question *Can learners improve both their Mathematical thinking skills and second language skills through a CLIL Approach?*, it was important to start by acknowledging some significant issues that were fundamentally connected to this research question, such as content language and integrated learning and its applicability to this project, task-based learning as a suitable approach that provides a clear and flexible framework to help organise the teaching cycles for the English Club, advantages and disadvantages of using cooperative work with young learners and the issue of assessment, more specifically self and peer-assessment with such young learners.

Part II – Literature Review

With the main aim of identifying a suitable approach that combined Content and Language learning within this action research to be developed amongst young learners at primary level, Content and Language Integrated Learning (CLIL) presented itself as the appropriate option to address this combination of the two items, Mathematics and English, as a dual input within a teaching cycle that would reflect possible improvement on both.

1. Content and Language Integrated Learning – CLIL

Over the years, English Language Teaching professionals and analysts have been identifying certain areas that could both improve and/or change how a second language is taught (Chaudron, 1988). Content and Language Integrated Learning (CLIL) seems to meet the demands of this new trend to improve how foreign languages, such as English, are taught and learned together with subjects like Science, Social Studies, Mathematics, Arts and much more. In this case study, we are mainly concerned with English Language teaching combined with the development of Mathematical skills such as Logic and Deduction.

1.1. What is CLIL?

According to Coyle, Hood and Marsh (2010) during the 1990s, the term CLIL emerged in Europe and originated a whole new approach in the ELT field. Although it may seem fairly recent, the idea of a content language integrated learning programme dates back some hundred years. For example, in medieval times Latin was used to teach all subjects as it was considered to be the most prominent language of that time.

The historical background of language integrated learning, where a foreign language is used to teach/communicate knowledge, has contributed to new developments in our contemporary society (Marsh and Frigols, 2007). The world is now facing a phenomenon called globalization that seeks to integrate all nations through new technologies and exchanges of information and knowledge. In this scenario, it appears to be reasonable that integrated learning can be seen as something modern and programmed to supply learners with extended knowledge and skills that will help them to take part in this new age of globalization. According to Trudgill (2000), English has become a lingua franca and, along with it, has emerged the desire to improve how this language is taught/learned due to the need of a more unified and communicative Europe.

Although CLIL is being used in many European countries, there are still some doubts about what CLIL really is. Many researchers have come up with definitions for the term. Coyle (2007:545) referred to CLIL as "an umbrella term" that shields several concepts together; she furthers her definition by adding that CLIL's essence "lies in an

integrated approach, where both language and content are conceptualised on a continuum without an implied preference for either"

All definitions seem to concur with the idea that content and language integrated learning is an educational approach that has a dual focus – Language and Content. According to Coyle, Hood and Marsh (2010), CLIL is a strategy for learning a foreign language that creates a learning environment that is both language and content driven. The focus is neither just the language nor just the content, it is a merge of both where one is not more important than the other.

The description presented by Mehisto, Marsh and Frígols (2008) provides us with an appropriate definition of CLIL which is a point of reference for this Project. As language is the means of communication, learners are naturally motivated to use/learn the language in order to understand the content. If learners are using the language to complete tasks and to communicate, they will more easily and sometimes even subconsciously assimilate chunks of language and identify patterns and will naturally apply that knowledge when using the language, whether in spoken or written production. It has also been mentioned that there is a third focus/goal in the integration of language and content that is discreetly developed when a CLIL strategy is adopted This third ingredient refers to the development of learning skills which help learners achieve their goals as far as content is concerned (Mehisto, Marsh and Frígols, 2008).

We should keep in mind that it is also the teacher's duty to ensure the content is delivered with the teaching of the language, so that learners do not find any obstacle in mastering the content because they do not master the language. On that note, teachers need to fuse both content and language and provide necessary aid to both. According to Coyle, Hood and Marsh (2010:4), CLIL is an approach that is related to processes of convergence, which means that this approach "involves the fusion of elements which may have been previously fragmented, such as subjects in the curriculum. This is where CLIL breaks new ground." Therefore, the fundamental nature of the CLIL strategy is integration, which, in the case of this project, is the convergence of the Mathematics curriculum and second language curriculum with very young learners.

1.2. Why CLIL?

> " Schools find it very difficult to accommodate different learning styles because they need to standardize what and how subjects are taught to suit the *learning profile image* of the up to 30 youngsters sitting in each class. And yet, each of those youngsters will have different backgrounds, needs and aspirations. This means that either personal learning styles may not fully suit the approach which the school uses. This issue affects all subjects, but particularly mathematics and language. (...) By offering an extra support experience, CLIL can give more children even better opportunities to develop their language skills in your school."
>
> (Marsh, 2000:5)

This claim by Marsh is intrinsically related to this Project's aim of providing learners with new opportunities to improve in both Mathematics and second language skills through rich and holistic experiences.

As researchers discover more elements regarding the process of how we develop our thinking skills and naturally our language skills, new approaches have also emerged that stem from the desire to better our learners' competences. CLIL offers exactly that, the opportunity to respect all learners' features and engage them in using the language so naturally that, at some point, they forget about the language and are concentrated solely on the topic. CLIL allows young learners to practice what they learn while they learn. This process has a very significant impact on how we develop our thinking skills and it is important to allow youngsters to experience this approach (Dalton-Puffer, 2007). For many subjects, our brains need to develop several skills at the same time. Marsh (2000) saw music as a great example of this plural acquisition of knowledge for one single subject. When a child is learning how to play an instrument, that child needs to develop competences on mastering the instrument hands on, while also mastering musical language. Language should be given the same opportunity: children should be able to learn the language and *play* with the language, but with traditional teaching that is virtually impossible.

Coyle, Hood and Marsh (2010) have presented two main reasons to justify why so many European countries have shown interest in, and even adopted, a CLIL approach. They have identified reactive reasons and proactive reasons. For the benefit of this project, let us focus on proactive reasons. According to Coyle, Hood and Marsh (2010), the implementation of CLIL is proactive in the sense that, by adopting this approach, schools can proactively create situations that will better language learning. Dalton-Puffer (2007) explains that, due to the dual focus of this approach, English language

classrooms become different, and while learners learn different subjects using L2, teachers create a reservoir of situations where real language emerges through real communication. She further states that CLIL has been able to combine communicative language teaching and task-based learning in one single approach that ensures the use of L2 in the real communicative aspect of the learning process. This approach that surfaced from the combination of two language strategies is the methodological base for this case project, where communication and content are taught through a task-based learning/teaching process that allows young learners to experience with the language and content.

For these reasons, in Europe CLIL has greatly expanded in relation to other learning and teaching approaches, and it has been implemented in many countries, from primary to higher education, with many different purposes, by native teachers and non-native teachers in various contexts. Kachru (1990) has called these communities where English is being taught as a means for communication in this global village as an expanding circle. One of the countries inside this circle is Finland, which was also a pioneering country in adopting a European CLIL programme. According to Jäppinen (2005:149), by 1996 in Finland, 8% of primary schools and 15 % of secondary schools had in some way or another adopted a foreign Language as a means of teaching numerous subjects. The main aim of this approach has been to give learners better opportunities in their professional lives and expose them to a "multicultural and plurilingual world." Another European country that has embraced a CLIL approach is Austria; in the early 1990s, it propelled a "foreign language offensive" in order to improve teaching/learning a second language in Austria. Statistic data provided from Eurydice (2004/2005) reveal that in Austria almost 7% of all secondary schools, 27% of all academic secondary schools and one third of all technical and vocational schools and colleges give priority to approaches that provide learners with intensive language training.

As stated earlier, CLIL promotes attitudes and strategies that allow teachers to expose a language that will be learned naturally through the need to communicate. In this project, second language will be the means of communication, whereas young learners will focus their attention on the content through a task.

With this approach, this project also aims to illustrate that teachers can help learners develop the ability to think in the target language and not just simply and plainly learn

the language. In order do this, English teachers can embrace other subjects like Mathematics in the L2 classroom and relieve the pressure from the language, allowing learners to develop thinking skills, language skills and mathematical skills, through a truly rich learning process. Marsh and Lange (2000:8) have stated that "being able to think about something in different languages can enrich our understanding of concepts, and help broaden our conceptual mapping resources. This allows better associations of different concepts and helps the learner go towards a more sophisticated level of learning in general."

1.3. CLIL and Mathematics

No matter what subject is being taught, language is an essential element of the learning/teaching process. Concerning Mathematical teaching, content is intimately connected to language as a means of communication, but also language as a cognitive process within the thinking process. In this sense, language may represent an obstacle when not mastered by the learners, due to the fact that Mathematics has a language of its own, its terminology is highly specific, complex and abstract. This language needs to be learned and understood in L1 and L2. Naturally, in a CLIL situation where mathematical skills are developed within a second language context, teachers need to be aware of the linguistic aspect when using L2 as a means of giving instructions. Cantoni-Harvey (1987) has advised teachers to use group activities as a strategy to highlight and engage learners in the dual focus of the process. Weaker learners can benefit from the help of stronger learners and cooperatively achieve a mathematical goal.

Mathematical language involves more than the linguistic element; it is also very visual as it implies several symbols and visual features such as graphs and diagrams. O'Halloran (2005) believes that with proper training teachers can guide and help learners to enter the world of mathematical thinking and language using terminology. This combination of language and mathematical thinking is what Wilhelmer (2008) has designated as 'semiotic resources', which are strongly blended together in the mathematical area.

> "Language is often used to introduce, contextualize and describe the mathematics problem. The next step is typically the visualization of the problem in graphical or diagrammatic form. Finally the problem is solved using mathematical symbolism through a variety of approaches which include the recognition of patterns, the use of analogy, an examination of different cases(...)."
>
> (O'Halloran, 2005:94)

Learning Mathematics in two different languages has raised some doubts whether it might have a negative impact on mathematical reasoning. A study developed by researcher Jäppinen (2005) in Finland has presented valid data that may help to demystify this issue. The study has shown that it is possible for learners to explore mathematical concepts and meaning schemes in a foreign language. Jäppinen (2005) conducted a research in 12 Finish mainstream comprehensive schools that allowed this study to have experimental and control groups, aged 7-15. This research was mainly concerned with cognitive development and learners were tested, both in experimental and control groups, in two areas: Mathematics and Science. This study was quite refreshing as it presented CLIL communities with the assumption that it is possible, with favourable conditions, to develop mathematical cognition within a CLIL environment. According to Jäppinen, this development resembles what would be a natural mathematical cognitive development through L1.

When we combine Mathematics and language through a CLIL approach, we provide learners with the opportunity to learn content by using a second language. As suggested by Cantoni-Harvey (1987), a good way to introduce mathematical terminology is during warm up activities where words needed for the centred task can be explored and assimilated.

We should bear in mind that teaching Mathematics is complex and encompasses a much more rigid and planned curriculum than any other subject, and teachers ought to be sure that the language input is comprehensible from a mathematical point of view. And in order to grasp the immensity of Mathematics field with young learners, it is important to understand the development of mathematical reasoning and its correlation with the development of critical thinking skills at a young age.

2. Mathematical reasoning – Improving Critical Thinking Skills Linked to Logical and Deductive reasoning

Since this project involves very young learners aged 9 and 10, it is important to understand how their critical thinking skills develop and how they can be improved, notwithstanding the important role language has as a means of communication and understanding. Mathematical reasoning occurs when learners combine all the skills that define critical thinking – interpretation, observation, analysis, inference, explanation and self-regulation. This next section looks into the initial development of critical thinking skills within mathematical activities and mathematical reasoning regarding logic and deduction, and how young learners can develop and improve them.

2.1. Critical thinking skills in problem-solving activities with young learners

The concept of critical thinking has been the subject of many researches over the years. A hundred years ago, researcher, philosopher and educator John Dewey (1909) began a quest to present the world with a comprehensible definition of what Critical thinking means, what it represents and how it can be taught. He began by defining it as "reflective thinking", an active thinking process that is persistent and careful, that allows the individual to think for himself, raise questions, find solutions, analyse external information and be able to selectively create a logical and understandable set of beliefs that make up what we are. In this general definition, Dewey (1909) establishes a bond between thinking and reasoning, the idea that human beings possess the ability to reason, to analyse and give reasons for personal beliefs that naturally have implications on how we live, think and act.

Some years later, the co-author of the text that is most commonly used for critical thinking, Glaser (1941), presented a definition of critical thinking as a list of abilities human beings might possess or develop during their lives:

> "(1) an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experience; (2) knowledge of the methods of logical enquiry and reasoning; and (3) some skill in applying those methods. Critical thinking calls for a persistent effort to examine any belief or supposed form of knowledge in the light of the evidence that supports it and the further conclusions to which it tends."
>
> (Glaser, 1941:5)

Forty years or so later, Norris and Ennis (1989) created a simplified definition of critical thinking that is commonly still used, identifying critical thinking as sensible , reflective thinking that focuses on how we decide on what we should believe or do.

Fairly recently, Fisher and Scriven (1997) attempted to define this concept by adding to the above mentioned authors that critical thinking is an active interpretation and evaluation of the world surrounding us, through which we can observe, communicate, receive information and argue. He complements his definition by identifying several aspects that are inherent to this skilled process, namely its significant role in metacognition – thinking about thinking – as it allows us to question, interpret and analyse the surrounding world which leads to an explanation that involves processes of constructing reasoning, enabling us to draw conclusions from questions that emerge in our everyday life.

For young learners, such as the group that took part in this project, it was important to expose students to approaches such as CLIL, which provided them with the appropriate context to enrich their experience in the learning process and thus enhance their abilities and competences in areas such as critical thinking, alongside with language, so that their understanding of the world that surrounds them may become clearer and more authentic.

2.1.1. Critical thinking in Young Learners

Several researchers (Gelman and Markman, 1986; Kennedy et al, 1991; Willingham, 2007) have provided significant evidence to support that youngsters are capable of developing critical thinking from an early age and, within the appropriate context, are able to engage in complicated and complex cognitive processes just like adults. The consequences of this new approach to critical thinking of children have become evident in the curricula created for lower elementary years that engage young learners in numerous situations where basic critical thinking aspects are developed, especially in the subject of Mathematics. These researchers have asserted that children

of a young age are capable of critical thinking given the right training and orientation, and that the educational system should comprise the development of such abilities across all curricula. Thus, the understanding that by developing critical thinking in early ages children would be more productive and reflective in adulthood, has began to be much clearer.

However, Bailin et al. (1999) have defended that such ability does not emerge naturally; it has to be developed and improved over the school years. Facione (1990:27) defends that "from early childhood, people should be taught, for example , to reason, to seek relevant facts, to consider options, and to understand the views of others". Young learners, like the participants of this project, at elementary level are cognitively prepared to engage in critical thinking development and should be taught several aspects that can help them, such as: learning to value truth and reason; learning to respect the opinions of their peers; learning to keep an open mind; distinguishing the reliability of different sources of information; learning to be able to see the world through different perspectives; developing cognitive strategies like asking for clarification; learning to develop critical thinking principles such as observing, analysing and interpreting all possibilities, before drawing conclusions.

The American Philology Association (APA), in 1990, came up with the Delphi Consensus Report on critical thinking, which was the result of a two year project that articulated an international expert consensus on what are the core critical thinking skills and subskills. Facione (2011) has created a framework of analysis (Appendix XIX) illustrated in APA's report, regarding what critical thinking involves and implies. He identified six important skills that represent the core critical thinking skills – interpretation; analysis; inference; evaluation; explanation; and self-regulation. The report also provided a description that resulted from experts' consensus. In addition, Facione's framework has allowed us to deepen our knowledge of such skills, by adding to each skill subskills which facilitate the understanding of how these skills develop and evolve in learners. This framework of analysis is fundamental to this project, as it provided the core principles from which the tasks were organized and how the several critical thinking skills were distributed in each task or mini task within the teaching cycle.

2.2. Logical and Deductive reasoning in problem-solving activities

Mathematics in the classroom offers an extraordinary atmosphere for critical thinking development to surface, as it presents a rich curriculum that highlights the need to provide students with tasks that allow young learners to engage in a voyage through the core of critical thinking skills. This is especially the case for two mathematical skills – logic and deduction – that go hand in hand with the development of critical thinking, as young learners require the ability to read a logic and deductive problem-solving activity and interpret that data, analyse, infer, evaluate and explain reasoning and finally self-regulate to be able to assertively draw the right conclusions and present valid answers to the ignition problem-solving activity. According to Paul and Elder (2008), critical thinking skills are essential to our existence, and the quality of our thoughts is intrinsically connected to the quality of our life. The balanced development of the skills mentioned above can lead to a good development of many other skills such as logic and deduction.

2.2.1. Logical and Deductive reasoning

Before exploring the concept of reasoning, it is important to look at what reasoning is. According to Holvikivi (2007:368), reasoning is "a central component of cognition that depends on theories of comprehension, memory, learning, visual perception, planning, problem-solving, and decision making.". There are two main types of reasoning that derive from logic – deductive and inductive reasoning. For this project, the focus is on deductive reasoning.

Even and Ayalon & Even (2010:1131-1132) have described deductive reasoning as the ability that one has to infer "conclusions from known information (premises) based on formal logical rules, where conclusions are necessarily derived from the given information and there is no need to validate them by experiments.". To clarify this statement, here is an example of a deductive reasoning through syllogism:

Premise A: All oranges are fruits.
Premise B: All fruits grow on trees.
Deductive reasoning – Oranges grow on trees.

Through deductive reasoning, we can also draw more complex conclusions that are not obtained from syllogisms. For example:

Every day I go to work.
It takes me an hour to travel from home to the school where I teach.
School starts at eight o'clock in the morning.
So, if I leave home at seven o'clock in the morning, I will get to work on time.

As mentioned before, deductive reasoning is a constant process people engage in whenever they need to make decisions based on some information. This process is central in the context of a Mathematics lesson. According to mathematical researcher Eves (1992) deductive reasoning is synonymous with Mathematical thinking.

Vygotsky (1986) has contended that deductive reasoning must be taught as such ability is not naturally developed. Other researchers such as Lehman & Nisbett (1990) have argued that some features of reasoning develop naturally in infants, although formal education has an important role in improving deductive reasoning in young learners.

It is important to highlight that deductive reasoning is dependent on language. We need language to develop our reasoning. The main concern of this project is to research and understand whether young learners are able to improve their logic and deductive reasoning not by developing their L1, but by developing their thinking skills in a second language.

2.3. Storytelling and Mathematics

> "[Storytelling] can take many disciplines from the realm of the often dreary textbook and raise them to great heights of exciting, fruitful experiences in learning. Storytelling as a pedagogical technique has been used by the world's greatest teachers. Jesus used it, as did Plato, Confucius, and other great philosophers and teachers. . . . The modern teacher who employs this technique as a teaching tool is using a technique of teaching that has stood the test of time."
>
> (Chambers, 1970: 43).

Story telling is a part of our lives from a very early age. Our parents and grandparents have read us stories that helped us develop our imagination and creativity, helped us deal with our fears and opened doors that led us to a world of magic and wonder.

It is said that story telling is one of the oldest 'tricks' teachers use to engage learners and maintain interest. Pedersen (1995) has gone a little further and identified storytelling as a technique that is the very essence of the art of teaching. In this Project, storytelling functioned as a catalyst that engaged young learners in each problem-solving activity and also provided learners with language needed.

Mathematics being a subject that works mostly through abstract concepts with young learners teachers need to develop important strategies to help convey meaning and make the bridge from concrete to abstract. According to Zemelman, Daniels, and Hyde (1998) storytelling associated with mathematics helps develop mathematical language and allows learners to explore ideas and understand complex concepts. The use of imagination which is quite often triggered by stories, especially with young learners, makes the process of learning Mathematics more fun and meaningful (Goral and Gnadinger, 2006) helping learners to create visual images of complex concepts which will be more efficiently assimilated.

3. Language and Language Learning – Task-Based Learning (TBL)

This section looks at second language development using task-based learning as the core approach. TBL provides a comprehensible framework that allows young learners at primary level to engage in a task, in this case a mathematical task, while using a second language to communicate and reflect upon the task. In order to achieve a particular pedagogical outcome, which was to improve young learner's both second language skills and mathematical reasoning skills, Willis' (1996) framework provided an essential guideline for building teaching cycles that would focus on the desired outcome.

3.1. Task-Based Language Learning and Teaching – an approach

Task-based language teaching and learning was originally inspired by N. Prabhu (1987) in Bangladore, Southern India. It began as an experiment for teaching English to children in India, for whom English was a second language regardless of the fact that English is an official language used in India for public purposes.

Richards and Rogers (2001:224) have stated that "Language learning is believed to depend on immersing students not merely in 'comprehensible input' but in tasks that require them to negotiate meaning and engage in naturalistic and meaningful communication.". This claim reinforces the argument that task-based language teaching (TBLT) is an approach that identifies tasks as the main component of the teaching/learning process, allowing the focus of the process to be on the task, relieving the pressure that usually lays on the language itself, letting young learners use the language to communicate and perform the task. Willis and Willis (2001) have argued that TBLT naturally derived from the communicative language teaching movement because it is based on similar principles. Beale (2002) has also defended that Communicative Language Teaching has been an influence in second language teaching for many decades. He emphasizes the importance of communication in the process of learning a language. For many centuries, the premises behind the communicative approach to language teaching with young learners have been used not only for language but also applied to the acquisition of other competences, consequently, learning other subjects in a second language makes sense if portrayed through a Communicative approach that allows young learners to experiment with the language by using it in an authentic context and, more importantly, by using the language to communicate.

Feez (1998) has identified six key elements to TBLT that emphasize how this approach can be beneficial to the learning and teaching process and the development of a second language with young learners. The six elements are: lessons focus on the process and not so much on the product; focus on tasks that stress communication and meaning; tasks are carefully chosen as to engage the learner in a communicative and purposeful interaction; tasks should fit into one of two categories: they are either for learners to mimic real life situations, or must have a specific pedagogical aim inside the

classroom; all tasks, activities and syllabus are organised according to the level of difficulty; the level of difficulty can differ from various factors such as experience of the learner, complexity of the task itself, language and the level of help needed to accomplish the task.

In order to understand how TBLT can address the needs of language learners and the organisation and design of teaching tasks, Nunan (2004) has proposed a set of principles that should be kept in mind whilst adopting a task-based language teaching approach especially with young learners. In the context of this project, there was the need to plan a set of task-based teaching cycles which involved the improvement of mathematical thinking skills and second language thinking skills. This set of principles presented by Nunan (2004) was a fundamental base and support for the design of these teaching cycles. This tables gives a comprehensible description of each principle.

Principle	Definition
Scaffolding	It is important that tasks and materials give the support the learner and the learning process require. Teachers have a key role supporting the learning process, especially in approaches such as TBLT where learners face language input that is sometimes beyond their ability, which is the context in this project, where learners were exposed to mathematical language. The teacher will, therefore, assist the learner when required in an early stage. It is important to know when to carefully remove the scaffolding.
Task dependency	Tasks should be pedagogically sequential, they should grow out of or build up another task. That is, each set of tasks needs to be linked with each other so that the young learner is not constantly beginning a new mental scheme. When tasks are dependent, knowledge will naturally be reused on the next task and learners will have a feeling of comfort and familiarity between tasks.
Recycling	By encountering language items several times in different linguistic contexts, language acquisition will be richer and most likely it will allow learners to have a more holistic learning process. Also if young learners keep using the same chunks of language or expressions throughout the set of tasks, they will most probably assimilate the language they are using.
Active learning	When learners feel the need to use the language they are learning, they will learn it better as opposed to only producing language when required by the teacher. In conclusion, lessons should be planned so as to have the maximum opportunities for learners to use the language in authentic situations.
Integration	Second language should be taught as a whole and not as separate pieces of a whole. Within TBLT, language plays a secondary part, put it is still very important. Learners explore the language themselves as they use it to communicate, and by doing so learners will improve their learning process and not the other way around. With Communicative language Teaching combined with TBLT, one has come to understand that form was secondary and that language

	teaching should integrate all items so as to pedagogically unite the language and create relationships between all elements.
Reproduction to creation	According to Lightbown and Spada (2004) young learners are at ease when experimenting with the language even if their mastery of the target language is very limited. However, educators should bear in mind that these productive activities should only come when learners are ready to take the next step; otherwise, the whole learning process could break.
Reflection	Learners need to have reflective time while learning a language as it is part of the learners' training to be autonomous in their learning. As we will see in section 4 of this case study, young learners need a lot more training than an adult learner in order to become reflective. By reflecting on their own learning process and on what they are learning, they will 'learn-how-to-learn', which is pedagogically embedded in almost every SLD approach. However, TBLT gives particular importance to this aspect in the learning process as it engages learners in their own process, helping them to discover which strategies help them learn best and hence become better learners.

Table 1- Set of Principles for Task-Based Learning and Teaching adapted from Nunan (2004)

3.2. What is a Task?

The core element of TBLT is the task, but what is a task? Many definitions of a task have emerged.

Willis (1996) has argued that tasks should be seen as small teaching/learning items used inside the classroom that engage the learner in using the target language with a communicative purpose in order to achieve an outcome.

Estaire and Zanon (1994) go deeper as they identify two types of tasks: a task where communication is central and the learners' focus is meaning, and 'enabling tasks' where learner's focus is the linguistic features of the target language. Other theorists, like Stern (1992), believe that communication should be included in the criteria that defines a task; he furthers his definition by adding that it should include real language use and that learners' focus should be the task and not the item of the language they are learning. This definition is the closest to Willis' (1996) within the TBLT approach.

There is no consensus within the research area on what a task actually is. However, Ellis (2003: 9) has identified a list of "criterial features of a task" that helps us understand what a task should be. He believes that a task should consist of a work plan,

it should focus on meaning, it should involve authentic language use, it should include the four language skills, it should elicit cognitive process from the learners and it most definitely should have a communicative outcome.

For this project, the most relevant definition of task comes from the researcher who created a framework which functioned as the basis of the organization of the small action research presented in this project. Willis (1996) has argued that tasks should be seen as small teaching/learning items used inside the classroom that engage the learner in using the target language with a communicative purpose in order to achieve an outcome. Any content or any topic can originate a variety of tasks, and it is up to the teacher to select contents that will interest young learners and motivate them. In this Project, storytelling was specifically used to present the mathematical task and generate the right motivation to engage the young learners, within the task cycle generated by Willis's framework.

3.3. Task-Based Language teaching as a framework for ELT

As Willis (1996) has explained, TBLT should not be seen as a series of tasks; on the contrary, it should be regarded as the core element of a framework to help researchers and teachers organise their lesson planning and teaching. This framework consists of three elements: the pre-task, the task cycle and the language focus, which will be briefly presented.

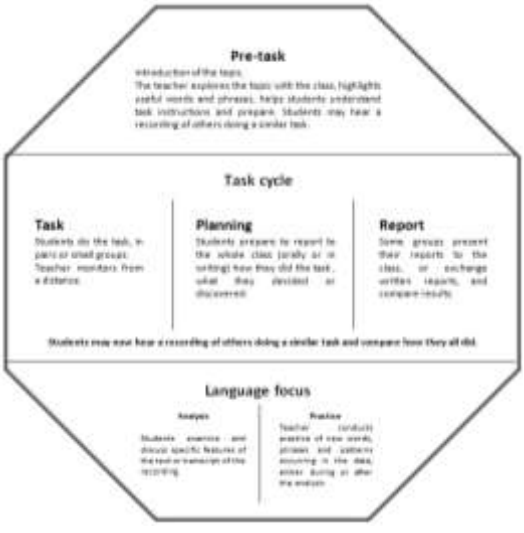


Figure 1. Adapted from Willis's(1996:38) framework of reference - TBL

The pre-task phase occurs when the teacher is setting up the topic and the task itself. At this stage, the teacher will introduce the language needed for the task. The type of activities that can be done in this part of the framework vary widely, from recordings of other students doing the task, power point presentations, written texts to audio stories. All of the above mentioned, intend to, as Willis and Willis (2007) have explained to allow learners to feel prepared for the task especially as far as language needed is concerned.

The task cycle is divided into three sections – task, planning and report. Learners, in pairs or groups, engage in a task. This section gives learners the opportunity to use the language that was prompted at the pre-task stage freely, as the teacher only monitors the task. Learners will then plan an oral or written presentation of how they carried out the task and what they have discovered. In this section, the teacher will function as guide and feedback provider, a role that is absolutely essential as learners are given help when it is most needed. In the last section (report) learners present their findings and results to the rest of the class, and this provides a very good opportunity to exchange language and have rich input while listening or reading each group's report. It is during the task cycle that three important conditions for learning a language are set – "exposure, use and motivation" (Willis, 1996:40). Learners will have experienced the language as a whole and not as separate pieces of a unit.

The language focus is the last section of the framework. At this stage, learners will analyse the language by discussing features they have identified during the task cycle. For this purpose, teachers may either present a recording of others doing the task or record the learners performing the task cycle, so that it can be analysed and discussed. Further on the language focus, the teacher leads an activity where learners can practice the new language identified in the first part of the language focus.

This task-based language framework allows learners to use the language to carry out tasks that result in an outcome. Because communication is a core element of TBLT, learners work in groups or pairs and teachers are usually guides, helping the learners to understand the task and language, and giving feedback to guide them in the learning process. In addition, teachers are seen as 'facilitators,' coordinating all factors involved in the learning process.

4. The Role of Group Work in Language Learning and Content Learning

> **"**Learners working together in groups were found to display greater motivation, more initiative, and less anxiety regarding their learning, they were found to produce more language. It also contained a greater number of features believed to assist message comprehensibility and thereby to serve as input for L2 learning."
>
> (Pica, Lincoln-Porter, Paninos and Linnell, 1996:20)

Group work is still regarded, by some teachers, as a strategy to avoid, because it involves movement and interaction, and at some point teachers feel they have lost control over the classroom and are, therefore, reluctant to put forth activities that engage young learners in pair or group work. This section approaches the benefits of this strategy, identifying the main aspects concerning learning through cooperative activities and developing language and mathematical skills. In this project, young learners worked mainly in groups, learnt and developed group work skills and joined in a cooperative learning process.

4.1. Cooperative Learning

> "There is more to group work than sitting pupils in groups and asking them to work together. By group work we mean just that – pupils working together as a group or team for a joint purpose or outcome. (…) Group work involves all children as co-learners and it incorporates all types of learning together – from cooperative and collaborative group work to peer tutoring and helping."
>
> (Baines, Kutnick and Blatchford, 2009:8)

According to Davidson and Kroll (1991), cooperative learning is a strategy that is commonly used inside Mathematics, Language and Science classrooms. It allows learners to interact and share knowledge, points of view and opinions, and enables learners to learn with each other. The small action research that emerged within this study adopted this strategy with the aim of enhancing the learning process of mathematical thinking through cooperative learning. Many researchers have provided us with clear definitions of what cooperative learning really is. Oxford (1997) believes that cooperative learning can be seen as a structured and rigid strategy for teachers, and much more directed to learners as they are encouraged to learn to work in groups.

Olsen and Kagan (1992) have offered a clearer definition for cooperative learning, which is fundamental for the research in this specific project. Olsen and Kagan have explained that cooperative work is a learning activity performed in groups, organized in a way that learning is dependent on the exchange of information between learners in which each learner is responsible for their own learning.

According to Baines, Kutnick and Batchford (2008), there can be three types of interaction taking place inside the classroom, either in a Mathematics or English lesson. These types of interaction can also be identified as learning contexts where young learners learn through three different inputs:

- Teacher and young learner;
- Young learner working on an individual task;
- Young learner with young learner – cooperative work.

For the last 10 to 15 years, cooperative learning has been taking on an important role in ELT, especially as regards to young learners. Teachers have come to the conclusion that group work activities can enhance and better learners' cognitive, social and emotional abilities. Such abilities are intimately connected to the learning process. To sum up, cooperative learning is an interaction between learners of the same age who work towards the same goal and together achieve knowledge.

4.2. Cooperative Learning in an ELT Class

Inside the L2 classroom, cooperative learning engages learners in productive and valid communication with one another. According to Oxford (1997), in an L2 classroom interactions can relate to four different aspects of interpersonal communication.

The first aspect concerns language tasks that promote interaction, like simulating activities - role playing, drama and use of ICT devices -, which allow learners to cooperatively gain knowledge. These tasks, as asserted by Scarcella and Crookall (1990), will also unearth significant amounts of authentic language, engage learners in an active participation in the task, and most certainly motivate and trigger interest, enabling learners to practise and develop communicative skills.

Another aspect is the willingness to communicate in the language classroom. If learners are given the opportunity to interact and communicate using the target language in a stress free environment, they will feel at ease to use L2 to complete tasks. According to MacIntyre (1994), learners, and especially young learners who are used to cooperative activities within the L2 classroom context, are more willing to communicate in the target language and more tolerant to ambiguity, have a low level of anxiety and feel comfortable enough to take risks in L2.

The third aspect is concerned with the fact that learning styles potentially influence L2 classroom interactions. Oxford (1997) claims that tasks can either have a high degree of interaction or a low degree, so it is important for learners that L2 lessons explore all learning styles in order to reach out to every learner; in that sense, they should evolve from a low degree to a high degree. The lack of variety as far as activities are concerned may constitute a learning problem when it comes to different learning styles. It is important that teachers survey their learners' learning styles so as to create lessons that result in what can be seen as a learning style harmony inside the classroom and avoid learning styles conflicts. It is important for teachers to recognize the preferred learning styles of their individual L2 learners, so they can prepare lessons that involve all learners inside the classroom.

The last aspect of interpersonal communication is group dynamics. Forsyth (2009) has argued that groups are a living system and we are bound to be part of groups and do cooperative work throughout our lives. It is important that, from our childhood, we develop skills that will allow us to function productively within a group. In this study, by working with young learners aged 9 and 10, it is appropriate to help them develop good group work skills that will be essential not only in school years but throughout their lives.

When learners achieve what Dörnyei (1997) calls "promotive interaction", which is the essence of good cooperative work, cooperative learning takes place. Johnson et al. (1995:20), who originally used the term "promotive interaction", has defined it as "individuals encouraging and facilitating each other's efforts to achieve and complete tasks, and produce in order to reach the group's goals.". Learners learn not only through teacher's input but also through peer input.

5. Assessment

According to Baxter (1997), in every teaching/learning context, assessment plays an important role both for teachers and for young learners. Also, assessment can serve several purposes such as: compare students' abilities; support students learning processes and ultimately verify whether the teaching programme is meeting its aims and goals.

By exposing young learners to moments of assessment where they can self-regulate their learning processes and progresses, we will be giving learners tools that will help them develop important critical thinking skills which will reflect greatly on their mathematical thinking development. Giving young learners the opportunity to observe, analyse and interpret their peers' progresses in the learning process will also supply learners with useful tools to develop thinking skills. Naturally, with young learners such as the group that took part in this Project, guidance is of importance and although, as stated by Lim (2007), several authors support the idea that assessment, to some extent, should be of the learner's duties since learning is first and foremost the learner's responsibility, they need to first learn the 'how' so that they can then improve and become eligible to take up the responsibility of their learning.

Assessment influences the development of motivation for learning. According to Stiggins (2001), motivation must be seen as the engine that ignites learning/teaching and, therefore, teachers and learners should take into consideration assessment as an important feature that affects motivation and thus the learning process. Stiggins has also defended that assessment can be a tool for teaching/learning that can either augment or diminish learners' needs and goals in the learning process.

McKay (2006:14) has claimed that "Young learners have a particular vulnerability that requires careful attention (…) When young learners are assessed, it is important that children experience overall success and sense of progressions". As a result, and as stated above, it is essential that learners participate in continual assessment of their learning process. To encourage this participation, self and peer-assessment are strategies that engage learners in on-going classroom assessment and enable students to unearth their own strengths and weaknesses allowing them to play a

more active role in their own learning process. Some guidance is expected so that learners can reflect on their own performance and their peers' performances.

5.1. Self-assessment

> Traditionally, teachers have judged students, through tests, assessments, analysis of their work, and so on. However, (…) it is very difficult to measure a student's ability accurately. In the end, there is only one person who knows how much they are learning: the student.
>
> (Baxter, 1997:57)

While analyzing self-assessment, Buttler and Lee (2010) have claimed that we should consider two key points. Firstly, self-assessment can be used for measuring the learners' degree of understanding and mastery of the language. Usually, it translates into a mark or grade that helps the learner's placement regarding the Educational programme. Also, teachers may make use of self-assessment tasks as a tool to help learners progress in their learning. By giving students the opportunity to reflect, analyse and evaluate their own performances, teachers supply learners with an important strategy that will most certainly help them improve their learning process and thus become better learners.

Secondly, self-assessment can and should be used as a learning tool, helping learners become more autonomous and in control of their learning process. Moreover, adopting this approach into English language learning/teaching allows a change in how teachers organise their lessons and curriculums. As Boud (1995), Dann (2002), Dickinson (1987) and Nunan (1988) have stated, the learning context shifts from a teacher-centred instruction to a learner-centred one. So the learner plays the main role as far as the learning process is concerned. With this role comes an enormous responsibility imputed on the learner, and because it has also been defended that acquiring knowledge intrinsically depends on the ability of the learner to self-regulate their learning according to their interests and aims, teachers' roles are also indispensible as they orient and help learners develop abilities and strategies they need to master.

As claimed by Buttler and Lee (2010), self-assessment helps learners become more aware of their needs as far as learning is concerned, to be more goal-oriented, to

develop several learning strategies according to each goal or need, and in the end it will make a good impact on the learners' self-esteem as it can offer them a wider knowledge of their learning ability and therefore engage the learner in a positive and responsible participation in their learning process.

However, according to Vygotsky (1986), many theorists believe that in early ages such as pre-elementary and elementary levels, learners lack the ability to stand back and accurately analyse their own performance in second language acquisition. Vygotsky (1986:13) has stated that it is human nature to gradually develop thought and, with that, our cognitive ability to absorb all the information that surrounds us. At an early age, students tend to be over optimistic about their own performance in every activity, so it is, without doubt and as stated above, extremely important that the teacher adopts an active role to orient learners in their self-assessment. Teachers should function as guides and constant feedback providers in order to help the learner to improve their self-assessment ability.

5.2. Peer-assessment

Over the years, learners have become more engaged as far as their learning processes are concerned. They have begun to take a more active role and, naturally, self and peer-assessment are now an important technique used inside the classroom, not only for ELT, but for any subject.

In his study in a Japanese elementary school with learners in the 4th year, Evans (2008) has described the enormous benefits that peer-assessment can have on a classroom where English is taught as a second Language. Evans has identified 10 benefits that will now be briefly presented.

1. Developing students' critical faculties.

   By reflecting on their peers' performances, learners will become more conscious of their own performances. Evans suggests that by reflecting on somebody else's strengths and weaknesses, learners will better their ability to unearth new strategies to improve their own strengths and overcome weaknesses.

2. Autonomous learning.

Evens claims that as learners develop and improve their ability to self-regulate their learning, they need less guidance from the teacher and become more autonomous and more and more independent from the classroom learning context.

3. Developing leadership skills.

In acquiring such skills, the learner will easily transfer them outside the classroom and use them in other realities. Moreover, Evens asserts that through peer-assessment learners should be able to give and receive advice on how to better themselves as students, and this helps learners widen their ability to lead.

4. Motivation.

According to this study by Evans, motivation increases when learners feel that they are responsible for their own learning, engaging them in every activity. In addition, by assessing and being assessed by their peers, learners pay attention to what others are saying and that keeps them involved in all classroom dynamics.

5. Multiple assessors

By being assessed by the teacher, themselves and their peers, Evans believes that learners have a just assessment as they have various feedbacks and, hence, have more opportunities to evolve and improve.

6. Continual assessment

Peer-assessment allows learners to have not only the teacher's final evaluation, but to be assessed throughout the course in numerous ways and through various perspectives.

7. Fairness

Teachers are seen as the most suitable element to evaluate students; however, some problems may arise if learners only have the teacher's assessment. Evans (2008) cites Thorndike's (1920) expression regarding teachers who are influenced by the initial impression they get from a student – the "halo effect". This effect can have a negative impact on the learner's course assessment. According to Evans (2008),

using peer-assessment throughout the course minimises the possibility of this issue arising, as peers' opinions on each other may influence positively the teacher's opinion of each leaner.

8. Classroom management

With peer-assessment being an active technique inside the classroom, less participating students feel the need to participate more. Evans highlights that peer-assessment also has a positive impact on second language acquisition as, by listening to their peers' opinions, learners get richer language contribution in terms of oral input. Another benefit sometimes overlooked is the fact that peer-assessment may help develop good relationships amongst the learners and allow peers to get to know one another better.

9. Attendance and punctuality

For many learners, these issues – attendance and punctuality – may compensate for lack of skills in the English language and therefore learners are motivated to be punctual and not miss English classes in order to have good peer-assessment.

10. Ownership

For some learners, the whole assessment process is quite confusing and puzzling. Evans believes that when learners feel that they are part of this process, assessment becomes much clearer and their participation in the ELT classes is validated for them.

This set of important items explored by Evans (2008) that justify the benefits of using self- and peer- assessment inside the classroom has influenced the use of this strategy within the action research of this study, especially regarding the development of critical thinking that will allow the assessment to be clear and transparent. Young learners need a lot of scaffolding and guidance while developing competences that will allow them to become critical of their own learning processes, and this also helps them to assess their peers in a fair and transparent way.

Notwithstanding the pedagogical importance such methods of assessment can have on ELT context, there are some concerns regarding peer-assessment and its validity as a classroom assessment technique. According to Lim's (2007) study on self-

and peer-assessment, such techniques can lead to several problems teachers might have to face. Lim has identified three issues regarding peer-assessment which teachers should be aware of. The first problem, and the one that theorists are more worried about, is the lack of objectivity, which automatically leads to the second problem, the validity of such a technique. With learners of a young age, several factors blur the objectivity required in peer-assessment. Learners tend to find it difficult to separate affective factors and, therefore, find it difficult to stand back and assess their peers. Moreover, to some extent, learners lack the meta-language needed and may poorly assess their peers as they do not possess the appropriate linguistic competence required for such task. The third and last concern has to do with learner training, because it is important as teachers to be aware that peer- or self-assessment needs training and lots of guidance, it is a skill that needs to be developed and improved just like any other.

However, we should keep in mind that giving the appropriate training and making peer- and self-assessment a regular classroom activity will allow learners to develop the competence needed to participate in an increasingly objective way in continuous assessment.

> "Self- and peer-assessment is a teaching strategy as much as an assessment strategy. The benefits for the children can be, amongst others, opportunities to increase their language awareness and the ability to talk about language (...), increase responsibility for their own work and a strengthened sense of being part of a classroom community."
>
> (McKay, 2006:166)

Part III – Research

1. How the Project work emerged – towards an understanding of the issue

As a primary teacher teaching Science, Mathematics, Social Studies, Portuguese and History, my main goal with every group of young learners is to help them acquire knowledge, develop their abilities, talents and skills in order to become functional members of our society. Over my professional years, I have come to realise that learners

tend to see Mathematics as a difficult and sometimes confusing subject. Therefore, over the years, it has become my personal goal to find techniques, approaches and strategies to demystify this misconception that young learners seem to have of what Mathematics is.

The concept of developing mathematical skills in young learners began while working on a previous small-scale action research. This previous piece of work was mainly concerned with techniques to encourage young learners to take greater responsibility in cooperative work while performing logic/deductive tasks. This action research was carried out with my then third grade students and was concerned with group work competences and skills that young learners need to acquire and develop during their primary years, especially in mathematical tasks which include logic and deductive activities. The study presented a small-scale action research that pointed towards the need to help young learners take greater responsibility in cooperative work. For this study, Task-Based learning was the approach chosen, using Willis' (1996) framework as a guideline.

The outcomes of this previous study began to formulate several follow-up research questions. The need to proceed with research in the Mathematics and second language areas, along with the desire to develop what I had already started as far as cooperative learning was concerned, allowed for a main research question to emerge: *Can young learners improve both their Mathematical thinking skills and second language skills through a CLIL Approach?*

This small project work led me to the next stage of investigation through an action research, which granted me the opportunity to explore this dual focus that emerged as a primary teacher and as a researcher. As far as my interests as a teacher are concerned, I aimed mainly at changing my young learners perspective on Mathematics, showing them that this subject can be fun, interesting and challenging, without being confusing or extremely difficult. Moreover, this project work was also focused on the improvement of the speaking skills in a second language – English. Furthermore, I aimed at continuing to develop group work skills so as to engage learners in cooperative learning. As a researcher, I aimed to identify a positive combination of approaches, fun tasks and learning context in order to improve fourth grade students' both logic and deductive skills and second language skills; understand the impact of group work activities in developing critical thinking skills; continue to develop cooperative learning

skills and analyse the results of this research in order to assess whether it is possible to improve young learners logic and deductive skills in English within a CLIL context.

2. Research Methodology

2.1. Action research

For this case project, the form of research adopted was *Action Research*. This type of research, according to Kemmis and McTaggart (1988), differs from others in three important features: it is put in practice by someone in the field (a teacher with her students); it takes place within a collaborative environment (a primary school); and its main objective is to gather enough data to change the ways things work either in the educational or the scientific context, among others. In this specific situation, it aims to change or to influence the small educational context in which this project was developed so as to implement new approaches that may enhance the learning process regarding the teaching of Mathematics and English language.

Another researcher, Wallace (1998), has referred to action research as a strategy that promotes reflection on one's performance, as well as involving a systematic gathering and analysis of data collected on a daily basis in order to be able to consciously make decisions that will have an impact on one's future performance as a teacher. Mcniff and Whitehead (2002:59) have identified self-reflection as what should be the core of an action research: "What action research stands for is the realisation of human needs towards autonomy, loving relationships and productive work; the urge towards freedom, creativity and self-recreation."

As action researchers, it is important to systematize the action itself through stages in order to create an action cycle that allows us to clearly monitor all steps towards analysing the procedures and ultimately finding the results of the cycle. The following table 3 presents five steps, of the six step sequence presented by Strickland (1988), taken during this small scale action research for this project.

Steps	Description
Identifying the issue	The school in question had already adopted a CLIL approach and implemented an English Club that explored subjects such as Science, Social Studies and Citizenship through a second language – English. A lot of the work was done in groups or pairs. The teachers responsible for this after-school club would sometimes complain that a lot of learners lacked the ability to work in groups. Also, the headmistress of this school was inspired by a course the primary teachers had attended on Mathematics Didactics and really wanted to incorporate this subject in the English Club. Two important issues emerged as research questions: Can students explore Mathematics in English? Can we improve learners' ability to work in groups? These were two starting points of this small scale action research.
Seeking knowledge	To fully understand these two issues, it was important to seek knowledge through a literature review that helped me define the two research questions that had initially emerged and to gather enough information to help me understand what could be done in order to find answers to these two issues. My literature review included research on the following areas: TBL, CLIL, Cooperative learning, assessment, Mathematical reasoning.
Plan an action intervention	As presented in the teaching methodology section, a small scale action research was prepared based on the literature I had read, aiming to improve learners' Mathematical logical deductive reasoning and develop cooperative work skills.
Implement action	To implement this action, we had to ask for permission to create an English club within the already existing one. Having that, we also needed to get permission from the parents of the students enrolled in the club, to use their work in this case study and also to record some of their work on video. Having solved that issue, we began this action research with an eight month plan that began in October. (Appendix I)
Observe action	During the small scale action research, several techniques were used in order to collect data that would allow me to reflect and understand the implications of this action in my teaching practice and in my learners' learning processes. (Appendix II)

Table 2 – Five steps taken in this small action research, adapted from Strickland (1988)

2.2. Data collection

With the intention of providing solid and valid research data to support this project's research question qualitative data was gathered, using different sources that resulted in a collection of relevant and significant information that proved able to provide this research with reliable evidence. As it is a social research, findings cannot be generalized but can provide a clear perspective of the results found.

It is important to be able to congregate different perspectives and points of view regarding the same area in order to validate the research. Data triangulation is a concrete way to validate our research. According to Polit and Hungler (1995), to triangulate within a research displays the ability to present at least two different aspects of the research that reinforce the researcher's capacity to interpret the findings.

> "Collecting different kinds of data by different methods from different sources provides a wider range of coverage that may result in a fuller picture of the unit under study… Moreover, using multiple methods increases the robustness of results because findings can be strengthened through triangulation – the cross-validation achieved when different kinds and sources of data converge and are found congruent."
>
> (Kaplan and Duchon, 1988:581)

In this research, several techniques were used to collect data and provide enough variety of information gathered to create the right context for data triangulation. The data collection techniques are described in depth in table in Appendix II.

♦ Self- and Peer-assessment – At the end of each cycle, learners would individually fill in a worksheet about what they believed their performance was like during the cycle. They would have to tick the level of commitment for each criterion. The levels would go from *inadequate; barely adequate; adequate; good; very good; excellent*. The criteria were concerned with learners' participation in the task cycle; spoken expression; critical thinking ability; group work skills; group work role; and the report. (Appendices III and IV). It aimed at allowing learners a reflective moment to analyse their own performance during the cycles; to give learners simple, clear and structured information on what the teacher expected from them, enabling learners to start taking control of their own learning process; to allow learners to develop their critical faculties; to engage learners in autonomous learning; to motivate learners to take greater responsibility in their performance; and to develop the learners' sense of fairness. The peer-assessment worksheet was quite similar to the self-assessment worksheet, using the same levels and criteria. However, in this assessment worksheet, learners would write their peers' names in each criterion according to their level of commitment during the cycle. Once again, this assessment was done at the end of each cycle. It aimed at allowing learners to have a reflective moment to analyse their peers' performances during the cycles; to allow learners to develop their critical faculties; to engage learners in autonomous learning; to motivate learners to take greater responsibility in their performance; to develop leadership skills; to allow the learner to be assessed by multiple assessors, broadening their perspective of their learning process; to develop the learner's sense of fairness.

♦ Questionnaires - Throughout the year, learners answered two questionnaires. Each questionnaire was designed using closed-response questions about learners' opinions on the level of difficulty in language and Mathematics; each task cycle; assessment tasks; and group work. (Appendices V and VI). It aimed at eliciting data from learners about

how they felt regarding the level of difficulty of the language; to elicit data from learners about the level of difficulty in problem-solving activities; to elicit data from learners about their perspective on how helpful cooperative work could be; to elicit data from learners on their general opinion about the teaching cycles.

♦ Teacher's check lists - At the end of each task cycle, learners would present their report of the task. The teacher filled in a checklist (Appendix VII) regarding several aspects of the report. Some aspects concerned the whole group (poster presentation, overall structure of the presentation, overall language use, finding the correct answer for the problem-solving activity), other aspects were only concerned with individual performance (spoken English language, mathematical terminologies; overall commitment to the presentation). The marks given were based on Common European Framework of Reference levels (Council of Europe, 2001).

♦ Field-notes - As learners had some moments of group work, I was able to keep a written diary which included personal records of the learners' use of language, group work commitment and individual learner's weaknesses and strengths. It aimed to gather relevant data for future analysis, regarding language; cooperative work; and mathematical reasoning.

♦ Audio recording - In the penultimate teaching cycle, a video recording was made on the following parts of the Cycle: *task and report.* Once again, it aimed at gathering relevant data for future analysis, regarding language; cooperative work; and Mmthematical reasoning.

♦ End of term test - At the end of the term, learners did a small test that included several testing techniques, such as matching, filling in gaps, labelling, multiple choice and a very small logic and deductive problem-solving activity. This test incorporated all mathematical items that had been previously developed during the year. (Appendix VIII) It aimed to gather relevant data for future analysis, regarding mathematical reasoning and to give learners feedback on their progress in mathematical thinking.

According to Wallace (1998), it is important to research on possible and most suitable techniques before starting the action research for two main reasons: to save time and because by selecting different techniques we can relate to various ways of thinking about our own investigation.

Some data collection procedures used in this study, such as field notes, were private and tended to be qualitative rather than quantitative, since they functioned mainly as forms of taking notes of things as they were happening which were relevant to my research.

Some private techniques, like teacher's checklists, which were also used in the data collection within the small scale action research, and the use of observation techniques such as video recording, are also common in qualitative data collection. They help the researcher to maintain objectivity towards the data collection, as they focus on the important aspects and do not lose track of the main objectives. Although video recordings can be seen as intrusive, especially with young learners, they are important tools for analysing the language used as they give the researcher important 'real time' data. In this specific study, one single recording was made. It was at the end of the last teaching cycle, and as it was a longer cycle and in order not to lose any important data, it was best to make an audio recording of all language use for further analysis.

These observational techniques used in this study are supported by researchers MacKay and Gass (2005:186), who have argued that observation is a valuable technique for classroom research, especially regarding second language research. "Observations are useful means for gathering in-depth information about such phenomena as the types of language, activities, interactions, instructions (...)".

Another important technique used in this project work was questionnaires, and also informal conversations with learners and teachers to gather data before the action research, which helped me to prepare the teaching cycles according to the learners' abilities and needs. The questionnaires were used to receive feedback from learners during the implementation of the action research, in order to assemble information about their points of view and perspectives on the processes they were going through. Moreover, small informal conversations took place in the middle of the year to assert whether teachers were experiencing any development or improvement in the learners' performances.

Collecting data through assessment also had an important role in this small scale action research. Baxter (1997) has argued that assessment is important to gather data on learners' abilities. A type of assessment that is commonly used is a test, which was one technique adopted in this study's data collection, consisting of a simple summative test that aimed to evaluate some of their mathematical knowledge regarding both mathematical logic and deductive reasoning and mathematical terminology. Another type of assessment used was self and peer-assessment. Because traditional testing does not attribute any learning responsibility to the student (Baxter, 1997), it is important to have other assessment procedures in data collection. Self- and peer-assessment fill that gap as they involve the learner in the learning process and, therefore, in the implementation of the action research. Self and peer-assessment procedures were used in this small scale action research as a crucial source of information, especially for learners, since they offered the subjects of this research clear information on what was expected of them and what their level of commitment should be. It also allowed learners to see what their peers' weaknesses and strengths were, helping them to understand how they could help their peers and who would be most suitable to help them.

Part IV - The Project in Practice - Improving young learners' both logic and deductive thinking skills and second language skills

1. Teaching Approach

With a view to understanding if it would possible to improve both young learners' mathematical thinking skills and language skills through a CLIL approach, it was important to expose young learners to a series of activities that would provide the opportunity for such improvement. With that aim in mind, an English club was developed which consisted of a thirty minute workshop once a week. Each session of the English club was organised based upon the task-based learning framework presented by Willis (1996). As previously stated in the literature review, task-based learning relies on a framework that allows teachers to prepare a teaching cycle which promotes opportunities for learners to learn by doing. This premise can be applicable to the teaching of a language, but also to teaching a content and language together through a CLIL approach.

Having that in mind, the teaching methodology for this case study was set up taking into consideration several important aspects of the teaching context, such as:

- Age of the learners;
- Number of students attending the English Monday Club;
- Level of English (through a less structured form of interview with the English teachers who better knew the group of students);
- Mathematical reasoning development.

The combination of these different aspects of the teaching context mentioned above allowed me to adopt a holistic methodology that relied on a theoretical base derived from Communicative Language Teaching, TBL, CLIL and Cooperative Learning, notwithstanding all the knowledge acquired over the last eight years from my own experience as an English and Mathematics teacher of young learners.

For the practical dimension of the teaching methodology, five cycles were developed within the TBL framework based on Willis's model (1996). Each cycle followed six steps. First was the **pre-task,** which represented a story that would give the context for the task, which was the next step. The **task,** which would be a mathematical task, would elicit learners to use their critical thinking skills to understand the task and their deductive and logic skills to accomplish the task with success. The following step was **planning,** where learners would plan a report for the rest of the class in order to present the mathematical reasoning that led them to the answers for the problem-solving activity. Then, learners would present the **report** through a poster or through a simple presentation. Learners would then be engaged in a **language focus** activity that would centre mainly in mathematical language in English. After that, learners would be elicited to take part in a reflective and critical assessment activity, where they would self-assess and assess their peers. The following diagram adapted from Willis's Framework shows how the cycle functions in this particular project.

TBL teaching cycle

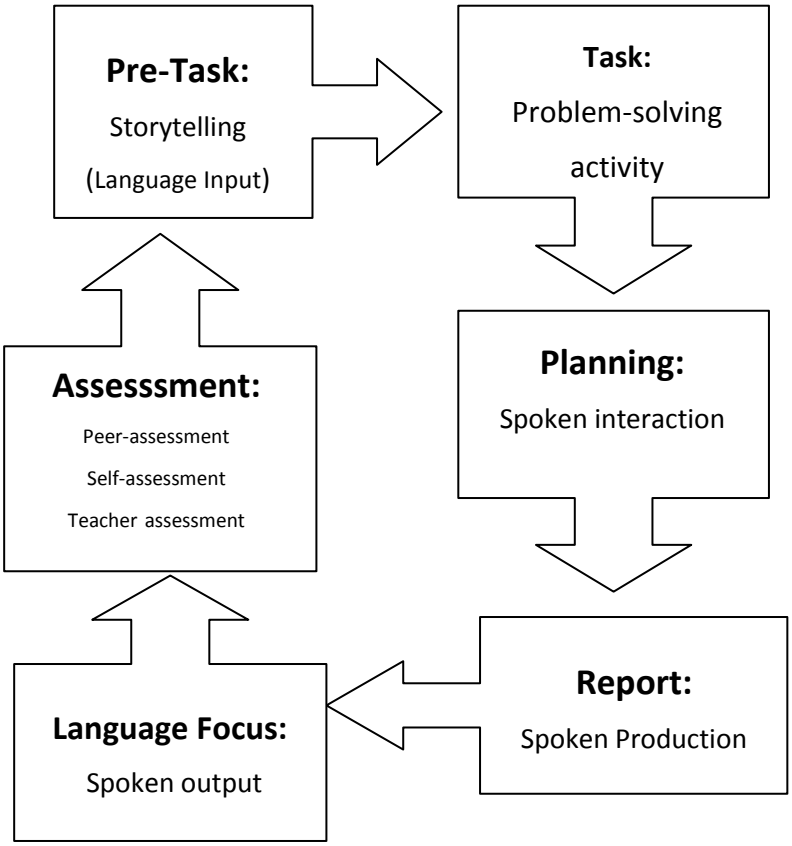


Figure 2- Task-based learning teaching cycle, adapted from Willis' (1996:38) TBL framework

The TBL teaching cycle presented above provided the model for the creation and design of five teaching cycles, and each one of the cycles followed the same six steps explained in the TBL teaching cycle, as can be verified in the table in Appendix IX, which provides a descriptive outline of the five teaching cycles.

Each of the five cycles began with a pre-task that consisted of a story line that set the context for the task. Each story (Appendices X, XII, XIII and XIV) was aimed at a dual purpose: to give learners important language items that would help them during the task and to introduce the task itself. The story was followed by a mathematical task that was incorporated inside the storyline. Each task had different levels of difficulty, starting with an extremely easy task in the first cycle and ending with a very difficult task in the fifth cycle. It is important to highlight that, as far as language focus is concerned, each task had two different inputs, the mathematical language and the second language.(Appendix IX). As for mathematical skills, the five cycles aimed to

direct young learners' mathematical reasoning to logic and deductive thinking skills. Regarding critical thinking skills, all tasks elicited the use of interpretation, observation, analysis, inference and explanation, all of which are core critical thinking skills. As the TBL teaching cycle in figure 2 shows, learners were then involved in a planning activity that led to a report session, where learners would present their findings and reasoning for the problem-solving task. They then filled in a self- and peer-assessment worksheet (appendix III and IV), where they would analyse their performance and the performance of their peers during three stages of each cycle – task, planning and report – regarding their participation, quality of thought, group work skills, group work role and their performance during the presentation.

2. Mathematical problem-solving activities through Story Telling – CLIL

As explained above, this Project took an action research approach which was based on a series of tasks that always emerged from a story that would introduce the centre task of the cycle. Since the target group was aged 9 to 10, stories can still be very motivating and interesting for these young learners. Consequently, storytelling was adopted as a strategy to elicit learner's attention and interest, motivating them to engage in each task.

As a teacher, storytelling is a technique that I have been using since I started teaching. It has helped me reach my students through affect, exploring feelings and points of view; sharing opinions, experiences, fears; developing healthy relationships amongst peers as they can relate to each other strengthening confidence between them.

For this project, I believed it would be an interesting way to approach mathematics through stories that they already knew or had heard of, to establish a relaxed atmosphere and create the right context to promote interaction.

Almost every story could be transformed into a problem-solving activity, in almost every story there is a problem to be solved; in general, it is not a mathematical problem, but quite easily a teacher can transform the story and adapt it to the needs of the lesson or classroom.

2.1. Which stories to use?

For this case study, and bearing in mind that all stories would be read in English, I chose stories that I was quite sure all students knew, so that the story would be easily understood and at this point language would not be an obstacle for the understanding of the problem-solving activity attached to the story. By reading already known stories, learners would feel confident about listening to the story and, at the same time, the initial excitement of listening to a story in L2 would simply disappear. As Cameron (2001) has argued, in storytelling the language should be pre-taught or pre-existing so that the storyline does not break and learners do not lose interest and motivation. Naturally, all stories told where slightly different as they were adapted, as mentioned before, so as to include a mathematical problem-activity.

For this action research consisting of five teaching cycles, five stories were carefully chosen. The main aims for including these stories were, firstly, to motivate learners and engage their attention, and, secondly, to create a set, a context to introduce the mathematical task which was the core of each teaching cycle.

After some research, I came up with a group of stories that would meet my needs and naturally my learners' needs for the English Monday Club. Some stories were adapted by published authors, others were adapted by me. The chosen stories were:

- **Maths Lesson** – This story was entirely created by me as I could not find a proper story that would provide the context to explore how students could develop good group work. It functioned as a bridge to highlight important features of good cooperative work and, by analysing a bad example of it, I could very easily elicit a lively discussion on how we should work as a group.

- **Little Red Riding Hood** – This was a perfect multidisciplinary activity as students went to see an interactive play in English performed by the theatre group Avalon Company. It was the story of Little Red Riding Hood, slightly adapted to have more characters because the students were invited to participate in the play by playing characters that either help or make things

more difficult for the heroine. This story created the perfect context for the logic and deductive game "How to cross the River".

- **Earth Day, Hooray!** – This was the only story the students had never heard before. It is part of a group of stories (Murphy, 2010) that deal with mathematical problems. They were developed by Stuart J. Murphy, a visual learning specialist, who contributed to this series with a handful of stories that help teach Math. This story set a perfect framework to develop mathematical language regarding numbers and the concept of grouping numbers.
- **Three Pigs, One Wolf, Seven Magic Shapes –** This book is also part of a series of Mathematic books *Hello Math Reader* (Maccarone, 1998) that approaches problem-solving activities through storytelling.

- **Sherlock Holmes comes to the Math's Club –** This story was taken from a book by Bullimore (1997), *Sherlock Holmes' Puzzles of Deduction*. It is a compilation of 118 puzzles of deduction, accompanied by humorous illustrations. The story itself was new to this particular group of young learners, but they all knew the characters and were very excited because it was a mystery that took place in our English Monday Club.

All stories, except the play, were introduced in a slide presentation using a Data Show projector that projected the story onto the white board.

Overall, this group of students responded extremely well to all the stories. Many of them wanted to buy the books, which proved that the stories were having a positive effect by keeping learners interested and engaged.

3. Teaching/Learning Materials

Along with the storytelling, the teaching cycle was enriched with different teaching/learning materials that sometimes helped the learner to unravel the problem-solving activity, maintained learners' attention during the storytelling, functioned as a

language focus activity and also functioned as a pre-task for the main task. Thus, the teaching materials for the five cycles were:

- **Slide Presentations** – In an attempt to make the storytelling time more interesting and engaging, instead of reading the story from a book, I prepared four slide presentations which allowed me to simplify the stories and adapt the storyline to my needs as a lesson planner.

- **Games** – Some games were used during the teaching cycle, whether during the story or as the main task of the task cycle. During the story *Three Pigs, a Wolf, Seven Magic Shapes*, learners were elicited to participate in a game: *Shape Muddle*. The game allowed students to identify geometric shapes and solids in a fun and appealing way.

- **Worksheets** – Worksheets were used in different parts of the teaching cycle. Some were used during the storytelling, as language focus activities and also to give instructions about the various mathematical activities learners had to complete during each teaching cycle.

4. Assessment Cycle

As presented on the diagram in figure 2, at the end of each cycle learners would have an assessment cycle that consisted of three important assessment moments: teacher's assessment at the end of the report stage, followed by self-assessment and peer-assessment.

At the end of every teaching cycle, learners would present their reports with the result of the problem-solving activity, in groups. It was either an oral presentation or a poster presentation. For this assessment, I created a checklist (Appendix VII) that would give me important data on their evolution as far as organization, critical thinking skills and language use skills were concerned. Also, learners would engage in a reflective activity where they were asked to fill in two tables, one concerning their own performance during the teaching cycle and the other regarding their group work peers' performances. These assessment techniques provided this project with important results

related to the research question of the project, which will be further analysed in the next section.

Part V - Data Analysis and findings

The following section will present an overview of the data collected throughout this research which aimed at gathering information related to the research question that was the basis for this project work:

a) Can students improve both their Logical and Deductive skills and Second Language skills through a CLIL approach?

1. Improving young learners' both Logical and Deductive skills and Second Language skills through a CLIL Approach.

As presented in the earlier section of the context of this study, the group of young learners who took part in this project work were quite familiar with the English language, being that they have been in contact with it since they were three years old. The use of the English language as a means of communication in this situation was not seen as a possible problem, but rather as an opportunity to improve their speaking production and speaking interactional skills.

To be able to assess what were the students' expectations towards this new experience within the Mathematics' field, they were invited to fill in a questionnaire (Appendix V) which sought to unearth young learners' knowledge of their own abilities regarding Mathematics' meta-cognition and their skills regarding the English language. Also, the questionnaire intended to account for how learners felt about learning Mathematics in English and to gauge what were their opinions on working in groups.

What was interesting to realize was that all learners were extremely excited about this new experience and felt quite motivated to engage in this project. As a teacher and researcher, it was also motivating for me to work with this group and it gave me a clear starting point. This questionnaire unearthed important information regarding how learners feel about engaging in activities that combine language and content, how they see themselves as Mathematics and English language learners and how they believe group work could enhance their performance. The findings that resulted from this data

collection were quite encouraging. Seventeen of the nineteen students that participated in this questionnaire ticked “I like” in the first part (statements regarding English Language Learning); On the next section where learners had to cross a grade line from difficult to easy regarding their performance in language skills and although answers varied, almost all learners crossed quite near the word ‘easy’; The last section regarding group work skills all learners ticked “I agree” in all statements.

Although a few learners, at some stages of the questionnaire, ticked the “so and so” smiley or crossed the gradation closer to “difficult”, it was a general consensus that learners were interested in this new approach. Also, I had the opportunity to listen and observe parents’ opinions regarding this programme, as we had a meeting before the beginning of the English Club to present the project to the parents. It was quite remarkable to see parents motivated with the school’s initiative to innovate in the Second Language field, which already has an important focus in this school’s curriculum.

These two separate perspectives on the project – learners and parents – were an excellent starting point to organize and plan a small scale action research. The action research was based on a serious of five teaching cycles, which were laid upon TBL’s framework developed by Willis (1996).

It is important to emphasize that the first cycle served several purposes as it was the most appropriate time to:

- present learners with the model of each cycle;
- unearth leaners level of spoken English;
- give learners an introduction of how to work in groups.

Although this first cycle followed the TBL teaching cycle diagram shown in figure 2, it also created a context in which learners were engaged in the discovery of important attitudes that could lead to good group work which they planned to use for the next teaching cycle. The first story triggered a discussion among the students as it represented poor group work. This discussion helped me as a teacher to identify learners’ level of spoken English and provide learners with important chunks of

language needed to work in groups. By the end, we had created on the white board a list of expressions learners could use while working in groups, such as:

- Good idea;
- Yes, but....
- What about ...
- Any ideas?
- What do you think?
- Do you agree?
- Let's do that!

At the end, learners had received different language input, including English chunks of language that they could use during group work and mathematical language which was presented by the dialogue the characters had in the story.

During the task itself, as a researcher, I was able to take notes of learners' use of the English language and how their logic and deductive thinking was developed as they were solving the problem. From the data collected from my field notes, it was interesting to notice that they were making a huge effort not to speak in Portuguese and several times engaged in using the expressions displayed on the board. As figure 4 illustrates and from the mathematical perspective, it was motivating to see that most groups opened up their minds to solving the problem using different ways of obtaining the correct answer presented by the characters from the story – diagrams and drawings – but one group could not distance themselves from what Mathematics generally conveys – numbers and figures. So, almost all groups presented their results through diagrams and drawings, but one group was girded to numbers and multiplications, which was acceptable and also gave me an opportunity to help this group develop their logic and deductive thinking, and help them go beyond numbers and counts.

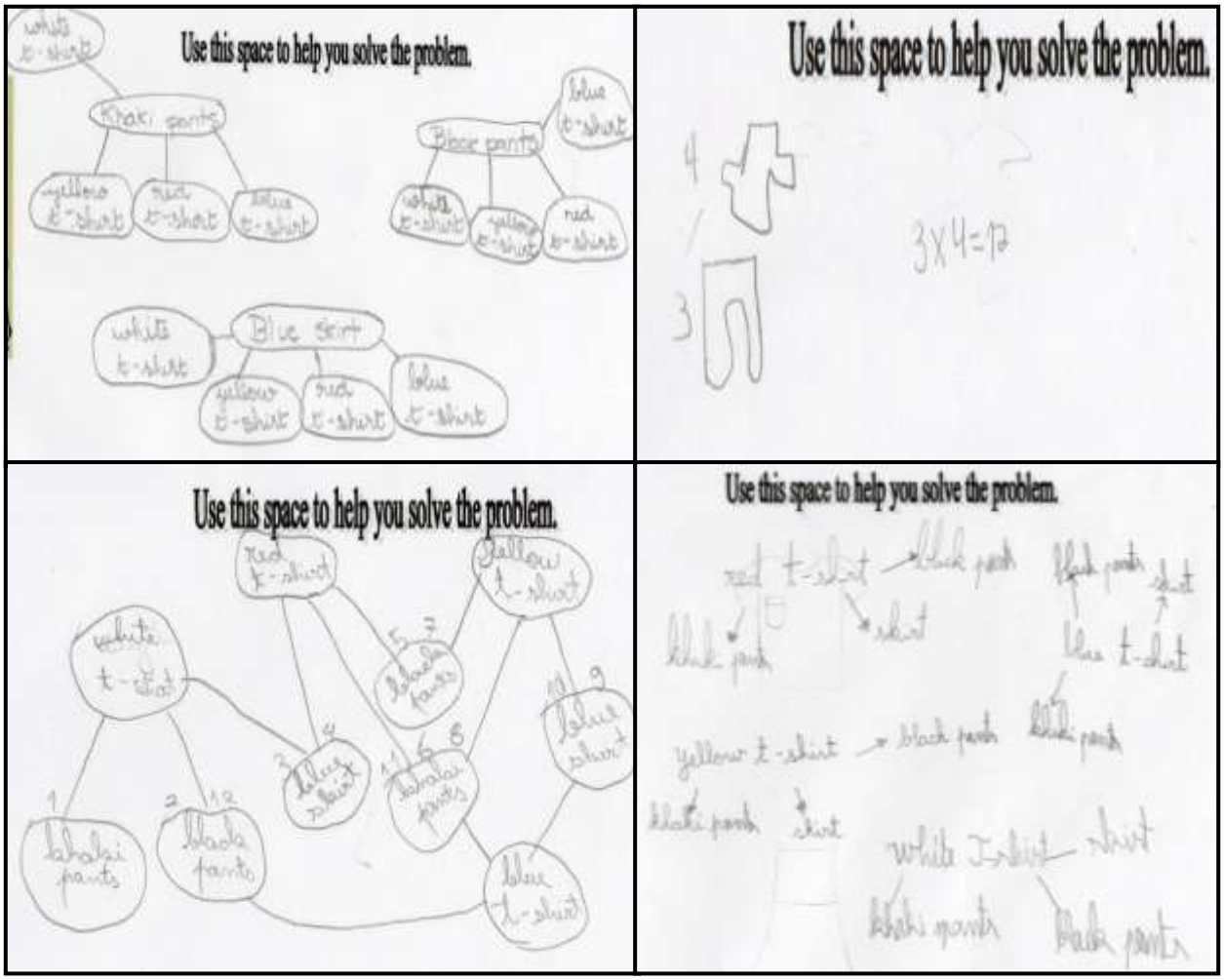


Figure 3 – First problem-solving activity outcome

After solving the problem while using the already existing logic and deductive thinking skills, learners had to prepare a report to present to the rest of the class their answer to the problem. They also had to explain how they had obtained that answer. This part of the teaching cycle gave me, as a researcher, a useful background setting regarding the level of mathematical language learners had and how their level of spoken English was. As a teacher, it gave me the opportunity to take notes and identify which language focus I should develop next and whether the level of difficulty of the task should be upgraded or not.

Interestingly enough, all reports took the form of telegram-like discourse. For example, when groups were presenting their results, language use was very simple and consisted of short utterances.

- “The answer is twelve outfits.”
- “It’s twelve.”
- “We think twelve outfits.”
- “Twelve.” (answer uttered by the shyest group)

It was quite clear that the next stage of the cycle – language focus – had to involve some input of language regarding how to present a report. So, the following week, learners had to complete a specific task, where they had a small text with a written report of the same task they had done the previous week. (Appendix XVI) With this task, learners were exposed to expressions and chunks of language that would be useful for reporting their presentations. By using this strategy, I was hoping that in the next teaching cycles, learners would have integrated these expressions so that they could enrich their use of the English language during the tasks and especially in their presentations of the task report.

For the following three teaching cycles, learners were engaged in three different tasks that involved different levels of deductive and logical thinking. I will now introduce, very briefly, the data gathered from the three cycles (see table in Appendix IX) and how second language skills and logic and deductive thinking skills evolved throughout.

The second teaching cycle consisted of Little Red Riding Hood’s story, followed by a problem-solving task. During the task and the preparation of the report, notes were being taken referring to the use of English language, how learners were cooperatively working and whether learners were correctly using their logical and deductive thinking, which led to a correct mathematical reasoning. I focused my attention on one group, which was the group that seemed to need more help to develop logic and deductive reasoning, and would also need more guidance in English language use.

S1: “ If we put *Capuchinho Vermelho* with Ogre, Ogre eats *Capuchinho*”

S2: “We put this with this, good?”

S3: “*Talvez* we can go *para trás e para a frente*?”

S1: “Yes, yes. Good Idea!”

S2: “E o basket? Goes *com quem*?”

S1: “Goes with Ogre. *Ah não* Ogre eats basket”

S2: “Francisco (S3) what do you think?”

S3: “Isto *não vai dar porque o Ogre vai ficar com a* Flower *e come-a*, flower *vai ficar com o* Basket e *come-o… Não dá*!”

After a long discussion, this particular group decided that this was impossible and they were almost giving up, so I thought it was time to give them a simple hint that would help trigger their logic and deductive thinking to solve this problem.

T: “What if you could move things back and forth so that the ogre isn’t left with the flower and the flower isn’t left with the basket?”

At this point, it became quite clear to them how they would have to logically move the characters around to complete the task successfully.

S1: “So If we take *Capuchinho* with flower first with?”

S3: “*A* flower *fica lá e volta a Capuchinho*.”

S2: “Yes, and then *Capuchinho* goes with Ogre *e traz de volta a* flower.”

S1: “*Capuchinho* takes basket *e deixa o* basket with the Ogre.”

S3: “*O* Ogre *pode ficar com o* Basket?”

S1: “Yes, it’s in the rules. Now *Capuchinho* takes the Basket *volta e* takes the flower. *Já está!”*

It was interesting to see that a simple clue activated their deductive and logic thinking skills and allowed them to analyse and interpret the problem-solving activity through a new perspective which altered their reasoning, allowing them to complete the task successfully.

At this point, learners were now ready to prepare the report and the presentation. I was asked if they could write what they had to say so they would not forget any important data they needed to make a good presentation. So, all groups prepared a small written text (Appendix XVII) that they would read during the presentation.

There are two important findings to highlight during this cycle. The first one concerns how they worked as a group. This particular group was formed by one strong mathematics student, one strong language student and a student who lacked in both areas. Our main purpose and hope for this group was that through a cooperative work they would learn from each other and would motivate each other to better themselves in each area they were less comfortable with. Taking into consideration the cooperative work, between Student 1 and Student 2, it was interesting to realize how they would engage with each other on the logic and deductive thinking and would reuse each other's expressions as part of their own language reservoir. As for the weaker learner in both areas, at a certain point S1 and S2 were so engaged that they excluded S3 out. I did not want to interfere and hoped that they would remember the discussion we had had on the first cycle and help the quiet student, including him in the cooperative work. And so they did. The fact that they were not able to find the right logic/deductive way to have the characters cross to the other side of the river made them resort to the quiet S3 and ask for help. It was quite fascinating to observe S3's reaction to the request for help – in fact, it boosted his motivation and self-esteem. Also, it was good to see that they used some of the expressions were from our list that was meant precisely for them to use when someone was not participating.

Another important finding relates to how they organised their language for the presentation and the fact that, in general, they felt the need to write it down so they would not forget anything. It gave me a sense that learners had consciously or subconsciously reflected upon their last presentation and reused most of the expressions they were exposed to in the Language focus from the previous cycle (AppendixXVI). Especially because they did not have the worksheet of the Language Focus, that meant they had had to absorb and assimilate the language chunks they had been exposed to.

I would like to emphasize the expressions used for the introduction and conclusion of the presentation. All groups used different approaches for these parts, which gave me, as a researcher, important data regarding language acquisition. These groups integrated new language chunks with the already existing language they had acquired and came up with new and original expressions, such as:

- "Hello, good, afternoon, we are the Maths Group"; "We hope you have enjoyed our presentation!"

- “This is our presentation. Listen to our conclusions”; “Now she escape the wolf”
- “Good afternoon, boys and girls. We are going to present our conclusion of this problem.”; “Thank you for your attention!”

The following cycles (cycles three and four) differed in mathematical language input and level of difficulty. Through field notes, observation and my own check lists (Appendix VII), I was able to accompany learners’ evolution in language learning and logic and deductive thinking. Most groups had richer dialogues among them inside each group and used less Portuguese, and they would also elicit less help from me as the language provider. As far as mathematical thinking skills improvement is concerned, on the one hand the weaker groups seemed to struggle more on the ‘how’ when trying to solve the task but kept needing less and less help from the teacher; on the other hand, the stronger groups were able to go from one task to the next quite easily using the concepts developed in the previous cycles, which meant they were improving quite quickly in both mathematical thinking skills and second language skills.

As the teaching cycles evolved, and especially through observing their interaction during the task and while the groups presented their reports, it was clear that they were more at ease with using the English language as a means of communication in the mathematical field. Moreover, they were very autonomous, as they already knew the cycle very well and seemed to be one step ahead in each of the stages of the cycle.

After four teaching cycles, it made complete sense to take a step back and assess how learners were feeling within this project, what were their beliefs and opinions regarding their own learning development in the area of mathematical thinking and language use. Each group was given a questionnaire (Appendix VI) that would, once again, assess learners’ opinions on the task cycle, how they were managing the level of difficulty in each cycle, how they were managing working in groups and also how they felt about the language they were exposed to. Furthermore, each student had the opportunity to have a small informal conversation with me to let me know where they were standing in each of this project’s domains. As a teacher, it gave me information of what were the learners’ needs so I could adjust my teaching. As a researcher, it put into perspective how each learner was coping with the learning process and progress. The results of the questionnaires and the informal conversations were quite good. The level

of motivation was still high and overall learners were still deeply engaged and curious about the next cycles. As a teacher, one of my fears was that, by understanding the sequence of the cycle, learners would lose motivation and interest as it was repetitive from one cycle to the other, even though they were exposed to different tasks and stories. Therefore, it was surprising to find out that the fact that they knew what the next step was, made them feel comfortable and less stressed. The cycle offered, thus, a positive scaffolding that, instead of demotivating learners, engaged them in bettering their performance, especially the weaker students who felt safe and unstressed by each new cycle. Another interesting data that surfaced from this questionnaire was the fact that, as the groups did not change, learners felt that, by getting to know each other better as peers and learners, they were able to help each other and put to good use each other's abilities and skills throughout the cycles.

With the data collected via the questionnaires and informal conversations, it was time to build up a last cycle that would involve all mathematical knowledge taught and developed in the past four cycles, and would bring to the surface all the mathematical reasoning development.

For this last cycle, learners listened to a story of a famous character (Sherlock Holmes) and they had to complete four problem solving activities, each requiring a high level of logic/deductive thinking and mathematical reasoning. As language is concerned, learners had not only to explain their mathematical reasoning for the four mini tasks, but also recall and retell the story. Learners had a single worksheet where they would take notes and write the correct answer for each problem solving activity. For this cycle, it was important to keep an audio recording to register language use and the way groups managed the level of difficulty of the mathematical and critical thinking skills required for this cycle. This was also the longest cycle and, as a researcher, I was wrried that field notes would be insufficient to gather all necessary data.

After analysing all data collected during the recording through a transcript (Appendix XVIII), it was clear that all groups had finished the task successfully and with little help. The audio recording of the last teaching cycle focused on the group that had presented itself as the weaker group and the group that had shown more improvement in both language and content. During this last story of the last teaching

cycle, learners were presented with four small logic and deduction problem-solving activities and a more complex one.

In terms of data analysis, it gave me the clear impression that learners had the skills needed to solve each task, which meant they had in fact developed their mathematical thinking skills. Especially the group I had focused on, they had no problem in solving all four tasks. And although this group struggled with some language issues, they were now much more fluent, extroverted and kept encouraging the quiet member not only to participate but to do so in English. Thus, they clearly felt more confident, so much so that they felt at ease to teach/help their peer. They would use connectors and linking words/expressions such as "So", "well", "because", "first", "next", "the last one". And although they knew I was recording and that would pressure them to make an extra effort and it does show in the transcript that they were very conscious and careful with their discourse, they went from a very quiet group in the first teaching cycle to a communicative and fluent group in the last one. For example, here are some utterances taken from the transcript of how they solved the first mini task that preceded the main task.

S2 – So we have Mr. Frank Mr. Richards and Mr. Andrews for last name

S1- And Andrew, Frank and Richard for first name né? Where are the clues?

S3 - Here. *Eu* read ok? None of the men's first name matched their surnames. *O que é* surnames?

S1- *É* last names, *apelidos, vá*…

S3 – Mr. Richards first name is Andrew.

S2 – *Raquel escreve lá essa.*

S1 – *English Miguel, a miss está a gravar…*

S2 - Raquel write Mr. Andrew Richards.

S1 – Easy… So Mr. Frank is Andrews and Mr. Richards is Frank…

S2 – Yes! Understand Francisco?

S3 - Yes…

S1 – There only two left it is *trocar* names, understand?

S3 – Yes…

It was very interesting to see how quickly they were able to solve each mini task and how they would verbalize it using expressions such as “Easy”, or “this one’s easy”, when they would find the correct reasoning to solve the problem-solving activity. This data offered clear evidence of their improvement in mathematical thinking skills and their increasing enthusiasm in each cycle, which showed me that the fear of not being able to do Mathematical tasks in English was decreasing, giving space for improvement.

If I had presented them with this cycle right at the beginning of the English club, some of the children could have solved most of the tasks, but not all groups would have been able to do so. Although the weaker group required my guidance more often than the other groups, I am confident in saying that they achieved their success, at the end of this last cycle, by their own means and through their own development in the Mathematical field. For instance, their oral presentation was completely different from their first one, where they only presented their report by saying the word “Twelve”. Here is a small sample of their presentation for the last cycle.

S1, S2 and S3 - Hello everybody, we are going to present our conclusions.

S1- For the first task the answer is Mr. Richard Andrews, Mr. Frank Richards and Mr. Andrew Frank

S3 – Next the task. We discovered that the next house is sixteen hundred and… no… sixteen thousand and three hundred and eight four…

S2 – The third task the answer is, Professor Moriarty kidnapped Miss Sally because she has a Math secret…

S1 – We found the sequence of the cards with the rules.

S2 – First the Queen of Hearts

S1 – Then the Ten of Clubs.

S3 – Then the Queen of Diamonds

S2 – Then the King of Spades

S1 – Then the Ace of Hearts

S3 – And last the Ace of Diamonds

S1, S2, and S3 – This is our conclusion, hope you like it. Goodbye.

It was also important to analyse this data from the language perspective. During reports, as the cycles developed throughout the year, learners' language use was getting more technical and accurate and, at the same time, as supported by data, learners felt confident enough to play with the language and improve their oral presentations. I would like to highlight the group which I had identified as the weaker group in language and in the mathematical field, because they began to use less Portuguese in their group work. Unlike what was portrayed in the extract of my field notes regarding the second cycle, in this last cycle this group made a huge effort to use as much English as they could, as we can see in the transcript. They experimented new approaches to Mathematics and felt more at ease to use other techniques rather than just numbers and counts.

Another useful piece of evidence regarding these learners' development in language and mathematical thinking skills was the informal conversation I had with these students' Mathematics teacher and English teachers. The feedback that emerged from these small discussions was quite positive and elucidative of these learners' progress and development. Overall, both teachers agreed that the English club changed learners' perspective of Mathematics and English Language. The Mathematics teacher highlighted two dimensions where she felt there had been more significant developments:

- Learners were more motivated for mathematical problems, which used to constitute a moment in the lesson where the engagement level would normally decrease;
- The results and conclusions for mathematical problems in the lesson were now richer due to the variety of different mathematical reasoning that emerged in each task.

This data collected from the informal conversations with the teachers as reported above, illustrates and gives me evidence that there was some development regarding Critical thinking skills and logic and deductive thinking skills. Learners have changed the way they see Mathematics, how they perceive it and how they use their skills to solve mathematical problems.

The English teacher also commented on some important differences she had encountered during this year of English club, although not many. She stressed that

learners seemed more confident in using the language and Portuguese speaking had decreased slightly in the classroom. But she did not observe much development in terms of language use. As a researcher, I can identify that lack of development as a consequence of the language focus of each cycle. Mainly, the language focus was related to mathematical and technical language.

Additionally, we had another important perspective added to this project work's data collection and analysis, which was the parents' perspective. At the end of the year, we had another parents meeting to assess the work developed in the Club. Parents' reactions and comments to this project were positive and, in general, they felt that their sons and daughters benefited from this English club and they were quite interested in continuing next year. This willingness to enrol their children in this club again next year was a positive indicator that parents were pleased with their children's development.

Part VI – Conclusion and Recommendations

This project's main aim was to understand whether it was possible to improve mathematical thinking skills, connected to logic and deductive thinking, combined with the improvement in second language skills through a CLIL approach with young learners. In order to assess that possibility, a group of young learners took part in a small action research project developed in an English club, integrated in the extra-curricular activities of a private school.

This small action research that took place within this project aimed to answer the research question *Can young learners improve both their Mathematical thinking skills and second language skills through a CLIL Approach?*, it has become clear that this group of young learners improved in both their mathematical thinking skills, connected to logic and deductive thinking, and second language skills, especially speaking skills – spoken production and interaction.

The data collected during this small action research within a specific context suggest that young learners can improve in both items integrated in the research question, through a CLIL approach. Regarding language, and in this specific project mostly spoken language, young learners were engaged in five teaching cycles based on the TBL framework provided by Willis (1996), where they were elicited to participate in group work using a second language – English. As a researcher, it was important to understand that these young learners were quite at ease with communicating in English; the main concerns rested upon the question of whether they could think; reason; infer; explain reasoning in English, and that was my biggest fear. As presented in the Data Analysis and Findings section, although this group of children tried, in general, to engage in all steps of the first teaching cycle making their utmost effort to use only the English language, as they usually do in everyday English lessons, they lacked the ability to explain their reasoning in a second language. Through storytelling and teacher guidance, these critical thinking skills began to unravel and a focus upon their L1 knowledge shifted to L2. Storytelling was a key element to this shifting knowledge, as it presented young learners with chunks of language, mathematical terminology and thinking systems to help them solve all problem-solving tasks in English. Even though some groups presented a faster learning pace and displayed almost no difficulty in engaging in all teaching cycles in English, what was interesting to observe was the

weaker students, who began the teaching cycles with silent group tasks and moved on to vivid speaking interaction during tasks and richer speaking production during the report moment. As far as mathematical thinking skills are concerned, this group of young learners participated in five main logic and deductive thinking tasks within a teaching cycle. Learners faced different levels of difficulty, which allowed them to build a depository of mathematical data that helped them solve the next task. The fact that all groups, some quicker than others, could move on to the next task solving each problem-solving activity successfully was a good indicator that they were actually improving their mathematical thinking skills. Nevertheless, it is not possible to generalize such findings as this project was small and unique in its focus that took place in a specific context regarding specific young learners.

It is important to highlight the role that cooperative work within a CLIL approach had in this project. It began with the organization of each group and the guidance for good group work procedures. From there on, the ability that learners developed in self and peer regulation through strategies such as self and peer-assessment allowed learners to experience true cooperative learning and understand the benefits of working together for a common purpose. From the field notes taken and the audio recording, it was clear that learners were taking the most of each individual's strongest skills to better the group's performance, helping the weaker and shyest peer and understanding their own strengths and weaknesses. Given the limitations of this being a small action research within a specific and particular context, it is clear that the findings that resulted from this project can answer the research question formulated in the beginning of this project work, asserting that using a CLIL approach through a TBL teaching cycle can indeed contribute to the improvement of both mathematical thinking skills and second language skills with young learners.

At this point, it is important to emphasize that as a consequence of this study and with the help of parents and the motivation of all these students, the school has now begun to develop new projects regarding approaches such as CLIL, seeking to implement them within the school's primary curriculum, with the ultimate desire to provide learners with a richer education both in the mother tongue and second Language which will include the continuity of this English Club. As a result of the positive response from the fourth year students to this project, the school could develop other projects regarding the combination of English language learning and Mathematics,

Science and Social Studies through a CLIL approach to implement with third year students and consequently with second and first year students.

Naturally, this project work is a single drop within the realm of English Language Teaching through CLIL. It represents a first step of an ongoing research that combines Mathematical Learning/Teaching and Second Language Learning/Teaching. This project could continue by developing through a CLIL approach other areas of Mathematics such as Arithmetic, Algebra or Geometry. The findings in this project suggest that storytelling had an important role on the construction of a bridge between Language and Mathematics therefore it is acceptable to recommend that storytelling could also be introduced in the Mathematical areas mentioned above.

Being an active part in this project work and this small action research allowed me to understand learners needs and my responsibility as a teacher to keep learners motivated and focused, providing meaningful learning moments that allow learners to have a balanced cognitive development.

Bibliography

Allwright, D. (2005) Developing Principles for Practitioner Research: The Case of Exploratory Practice, The Modern Language Journal, 89, pp.353–366

Anderson W. & Corbett, J. (2009) Exploring English With Online Corpora, Basingstoke: Palgrave MacMillan

Aston, G. (2001) Learning with corpora: an overview, In Aston, G (ed.) Learning with corpora,Houston: Athelstan, pp 7-45.

Ayalon, M. & Even, R. (2010) Mathematics Educators' Views on the Role of Mathematics Learning in Developing Deductive Reasoning, International Journal of Science and Mathematics Education, Vol. 8, No. 6, pp. 1131 – 1154

Bailin, S., Case, R., Coombs, J., & Daniels, L. (1999), Conceptualizing critical thinking, Journal of Curriculum Studies, Vol. 31, No. 3, pp. 285–302.

Baines, E., Kutnick, P. & Blatchford, P. (2009) Promoting effective group work in the primary classroom: A handbook for practitioners, New York:Routledge

Barwell, R. (2005) A Framework for the Comparison of PME Research into Multilingual Mathematics Education in Different Sociolinguistic Settings, In Chick, H. L. &Vincent, J. L. (Eds.). Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education, Melbourne: PME. Vol. 2, pp 145-152

Barwell, R. (2007) The Discursive Construction of Mathematical Thinking: The Role of Researchers' Description, International Group for the Psychology of Mathematics Education (PME31) Annual General Meeting Seoul, Korea, pp 49-56

Baxter, A. (1997) Evaluating your Students, Richmond Publishing

Beale, J. (2002) Is communicative language teaching a thing of the past? in Babel, Vol. 37, No. 1, pp. 12-16

Boud, D. (1995). Enhancing learning through self assessment. London: Kogan Page

Bullimore, T. (1997) Sherlock Holmes' Puzzles of Deduction, Sterling Publishing, New York

Butler, G. & Lee, J. (2010) The Effects of Self-assessment among Young Learners of English, SAGE, online athttp://ltj. sagepub.com/content /27/1/5.full .pdf+html [accessed 24 September 2010]

Cameron, L. (2001), Teaching Languages to Young Learners, Cambridge: Cambridge University Press.

Cantoni-Harvey, G. (1987) Content-Area Language Instruction, Approaches and strategies, Reading, Massachusetts et al: Addison-Wesley Publishing Company

Chambers, A. (1970) Storytelling and Creative Drama, Dubuque: Brown

Chaudron, G. (1988) Second Language Classrooms – Research on Teaching and Learning, Cambridge: Cambridge University Press

Council of Europe, (2001) Common European Framework of Reference for Languages – Learning, Teaching, Assessment, Cambridge: Cambridge University Press

Coyle, D. (2007) Content Language Integrated Learning: Towards a connected Research Agenda for CLIL Pedagogies, International Journal of Bilingual Education and Bilingualism, 10:5, pp. 543- 562

Coyle, D., Hood, P. & Marsh, D. (2010) Content and Language Integrated Learning, Cambridge: Cambridge University Press

Dale, T. & Cuevas, G. (1987), Integrating Language and Mathematics Learning, In Crandall, JoAnn (eds.) ESL through content-area instruction, Englewood Cliffs, New Jersey: Regents/Prentice Hall, pp. 9-54

Dalton-Puffer, C. (2007) Discourse in Content and Language Integrated Learning (CLIL) Classrooms, John Benjamins Publishing Co.

Dalton-Puffer, C. & Nikula, T. (2007), Empirical Perspectives on CLIL Classroom Discourse, Peter Lang GmbH: Frankfurt am Main

Dann, R. (2002). Promoting assessment as learning: Improving the learning process. New York:Routledge

Davidson, N. & Kroll, D. (1991) An Overview of Research on Cooperative Learning Related to Mathematics, Journal for Research in Mathematics Education, Vol. 22, No. 5, pp. 362 – 365

Dewey, J. (1909) Moral Principles in Education, Arcturus Paperbacks

Dickinson, L. (1987). Self-instruction in language learning. Cambridge: Cambridge University Press.

Dörnyei, Z. (1997), Psychological Processes in Cooperative Language Learning: Group Dynamics and Motivation, in The Modern Language Journal, Special Issue: Interaction, Collaboration, and Cooperation: Learning Languages and Preparing Language Teachers Vol. 81, No. 4, pp. 482 – 493

Ellis, R. (2003) Task-Based Language Learning and Teaching, Oxford: Oxford University Press

Estaire, S. & Zanon, J. (1994) Planning Classwork: A Task-based Approac,. Oxford: Macmillan, Heinemann

Eurydice (eds.) (2004/2005), Content and Language Integrated Learning (CLIL) at school in Europe, Austria, National Description 2004/05, online at http://www.eurydice.org/ressources/eurydice/pdf/0integral/071EN.pdf [accessed 12 June 2011]

Evans, D. (2008) Reflections on Peer Evaluation in an English Language Course, National College of Nursing, Japan, online at http://www.ncn.ac.jp /04_for_medical/kiyo/ar/2008jns-ncnj07.pdf [accessed 24 September 2010]

Eves, H. (1992) A Survey of Geometry, Boston: Allyn and Bacon

Facione, P. (1990). Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction. Millbrae, CA: The California Academic Press.

Facione, P. (2011) Critical Thinking: What It is and Why It Counts, Measure Reasons and The California Academic Press, Insight Assessment

Ferrance, E. (2000) Action Research, Northeast and Islands Regional Educational Laboratory At Brown University[Online], online at http://www.alliance.brown.edu /pubs/themes_ed/act_research.pdf [accessed 10 June 2010]

Fezz, S. (1998) Text-Based Syllabus Design, Sydney NSW: National Centre for En glish Language Teaching and Research, Macquarie University

Fisher, A. & Scriven, M. (1997). Critical thinking: Its definition and assessment. Point Reyes, CA: Edgepress

Fisher, A. (2001) Critical Thinking an Introduction, Cambridge: Cambridge University Press

Forsyth, D. (2009) Group dynamics, Cengage Learning

Furnham, A. (2005) The Psychology of Behaviour at Work – the individual in the organization, Psychology Press

Gelman, S. A., & Markman, E. M. (1986). Categories and induction in young children. Cognition, 23, 183–209.

Glaser, E. (1941) An Experiment in the Development of Critical Thinking, New York: Teachers College, Columbia University

Goral, M. & Gnadinger, C. (2006) Using Storytelling to Teach Mathematics Concepts, Australian Association of Mathematics Classroom, Vol. 11, No. 1, pp. 4 – 8

Harmer, J. (2001) The Practice of English Language Teaching, (3rd Ed.) Longman

Holvikivi, J. (2007) Logical Reasoning Ability in Engineering Students: A Case Study, IEEE Transactions on Education, Vol. 50, No. 4, pp.367 - 372

Hughes, M. (1991) Summing up the workshop. In Language Learning for European Citizenship. New-Style International Workshop for Language Teaching and Teacher Training (pp. 57-139) Report on Workshop 5A: Learning and Teaching Languages in Pre-School and Primary Bilingual Contexts. Council for Cultural Co-operation, UK: Council of Europe.

Hymes, D. (1972) On communicative competence, In Pride, J.B. & J. Holmes (eds.), Sociolinguistics. Harmondsworth, England: Penguin Books

Jäppinen, A. (2005) Thinking and Content Learning of Mathematics and Science as Cognitional Development in Content and Language Integrated Learning (CLIL): Teaching Through a Foreign Language in Finland, Language and Education, 19: 2, pp. 147 — 168

Johnson, D., Johnson, R. & Smith, K. (1995), Cooperative learning and individual student achievement in secondary schools, In J. E. Pedersen & A. D. Digby (Eds.), Secondary schools and co-operative learning (pp. 3-54). New York: Garland

Kachru, B. (1990) The Alchemy of English, The Spread, Functions, and Models of Non-Native Englishes, English in the Global Context, Illini Books Edition

Kaplan, B. & Duchon, D. (1988) Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study, MIS Quarterly, Vo. 12, No. 4, pp. 571 – 586 .

Kavaliauskienė, G. (2005), Task-Based Learning and Learning Outcomes in the ESP Classroom, Studies about Language, no 7

Kemmis, S. & McTaggart, R. (1988) The Action Research Planner, 3rd Ed., Deakin University Press, Geelong: Victoria

Kennedy, M., Fisher, M., & Ennis, R. (1991), Critical thinking: Literature review and needed research, In L. Idol & B.F. Jones (Eds.), Educational values and cognitive

instruction: Implications for reform (pp. 11-40). Hillsdale, New Jersey: Lawrence Erlbaum & Associates.

Kohonen, V. (1992) Experiential Language Learning: Second Language Learning as cooperative Learner Education. In Nunan, D. (ed.) Collaborative Language Learning and Teaching, Cambridge: Cambridge University Press

Krashen, S. (1981) Second Language Acquisition and Second Language Learning, Pergamon Press

Krashen, S. (1982) Principles and Practice in Second Language Acquisition, Oxford: Pergamon

Lehman, D. & Nisbett, R. (1990) A Longitudinal Study of the Effects of Undergraduate Training on Reasoning, Developmental Psychology, Vol. 26, pp. 952 – 969

Lightbown, P. & Spada, N. (1999) How Languages are Learned, Oxford: Oxford University Press

Lim, H. (2007) A Study of Self and Peer- Assessment of Learners' Oral Proficiency, Essex University, CamLing, pp. 169-176

Littlewood, W. (2004), The task-based Approach – some questions and suggestions, Oxford University Press, ELT Journal Volume 58/4, pp: 319-326

Maccarone, G. (1998) Three Pigs, One Wolf and Seven Magic Shapes, Cartwheel

MacIntyre, P. (1994), Variables underlying willingness to communicate: A causal analysis, Communication Research Reports, 11, pp. 135 - 142

Mackey, A. & Gass, S. (2005) Second Language Research Methodology and Design, Lawrence Erlbaum Associates, Inc

Mardziah, A. (1998), Problem-Based Learning in Language Instruction: A Constructivist Method, online at http://www.indiana.edu/~reading/ieo/digests/d132.html [accessed 25 August 2010]

Marsh, D. (2000), An introduction to CLIL for parents and young people, in Marsh, D. and Langé, G. Using Languages to Learn and Learning to Use Languages, Jyväskylä: University of Jyväskylä

Marsh, D. & Lange, G. (2000) Using Languages to Learn and Learning to Use Languages, University of Jyväskylä , Finland: UniCOM.

Marsh, D. (2002), (ed.) CLIL/EMILE – The European Dimension: Actions, Trends and Foresight Potential Public Services Contract DG EAC, European Commission

Marsh, D. & Frigols, Mj. (2007) CLIL as a Catalyst for Change in Languages Education, Babylonia, online at http://babylonia.ch/ fileadmin/user_upload/ documents /2007-3/marsh_frigols.pdf [accessed 12 August 2010]

McKay, P. (2006) Assessing Young Language Learners, Cambridge University Press

Mehisto, P., Marsh, D. & Frigols, M. (2008) Uncovering CLIL – Content and Language Integrated Learning in Bilingual and Multilingual Education, Macmillan Books for Teachers

McNiff, J. & Whitehead, J. (2002) Action Research: Principle and Practice, RoutledgeFalmer

Mehisto, P., Marsh, D. & Frigols, M. (2008) Uncovering CLIL – Content and Language Integrated Learning in Bilingual and Multilingual Education, Macmillan Books for Teachers

Moschkovich, J. (2002) A Situated and Sociocultural Perspective on Bilingual Mathematics Learners, Mathematical Thinking and Learning, 4: 2, pp 189 — 212

Moschkovich, J. (2009) Using Two Languages When learning Mathematics: How Can Research Help Us Understand Mathematics Learners Who Use Two Languages, National Council of Teachers of Mathematics, online at http://www.math.uic.edu/ chicagosymposia/Moschko%20NCTM%20Research%20Brief.pdf [accessed 10 June 2010]

Murphy, S. (2010) Earth Day – Hooray, MathStart Series, Harper Collins Publisher

Norris, S. & Ennis, R. (1989) Evaluating Critical Thinking. The Practitioners' Guide to Teaching Thinking Series, Critical Thinking Press and Software

Nunan D (1988). The learner-centered curriculum. Cambridge: Cambridge University Press

Nunan, D. (1992) Research Methods and in Language learning, Cambridge: Cambridge University Press

Nunan, D. (2004), Task-Based Language Teaching, A comprehensively revised edition of Designing Tasks for the Communicative Classroom, Cambridge: Cambridge University Press

O' Halloran, K. (2005) Mathematical discourse. Language, symbolism and visual images. London: Continuum

Olsen, R. & Kagan, S. (1992) About cooperating Language Learning, in C. Kessler (Ed.), Cooperative Language Learning: A Teacher's resource book (pp. 1-30) Englewood Cliffs, NJ: Prentice Hall

Oxford, R. (1997) Cooperative Learning, collaborative learning, and Interaction: Three communicative strands in the Language Classroom, in The Modern Language Journal, 81, pp. 443-456

Paul, R. & Elder, L. (2008) Critical Thinking: The Art of Socratic Questioning, Part III, Jornal of Developmental Education, online at http://www.eric.ed.gov/PDFS/EJ832681.pdf [accessed on 25 June 2010]

Pedersen, E. (1995), "Storytelling and the Art of Teaching", English Teaching Forum, **33** (1), p. 2, online at http://exchanges.state.gov/englishteaching/forum/ archives /1995/docs/95-33-1-b.pdf [Accessed 20 June 2010]

Pica, T., Lincoln-Porter, F., Paninos, D., & Linnell, J. (1996), Language learners' interaction: How does it address the input, output, and feedback needs of L2 learners? TESOL Quarterly, 30: 59-84

Polit, D. & Hungler, B. (1995) Nursing Research: Principles and Methods, Philadelphia: Lippincott

Prabhu, N. (1987), Second Language Pedagogy, Oxford: Oxford University Press.

Richards, J. & Rodgers, T. (2001) Approaches and Methods in Language Teaching, Cambridge: Cambridge University Press

Scarcella, R. & Crookall, D. (1990), Simulation/gaming and Language acquisition, (pp. 223-230), Boston: Heinle

Spada, N. & Lightbown, P. (2002) How Languages are Learned, Oxford: Oxford University Press

Stern, H. **(**1992) Issues and Options in Language Teaching. Oxford: Oxford University Press

Stiggins, R. (2001) Student-Involved Classroom Assessment. 3rd end. Upper Saddle River, NJ: Merrill Prentice Hall

Strickland, D. (1988) The teacher as researcher: Toward the extended professional, Language Arts, Vol. 65, No. 8, pp.754–764

Thorndike, E. (1920)) A constant error on psychological rating, Journal of Applied Psychology, IV, 25-29

Thurmond, V. (2001) The Point of Triangulation, Journal of Nursing Scholarship, Vo. 33, No. 3, pp. 253 – 258

Trugdill, P. (2000) Sociolinguistics an introduction to Language and Society, Penguin Books

Vygotsky, L. (1986) Thought and Language, The Massachusetts Institute of Technology Press

Wallace, M. (1998) Action Research for Language Teachers, Cambridge: Cambridge University Press

Walters, K. (1990) Critical Thinking, Rationality, and the Vulcanization of Students, The Journal of Higher Education, Vol. 61, No. 4 (Jul. - Aug., 1990), pp 448-467

Wilhelmer, N. (2008) Content and Language Integrated Learning (CLIL): Teaching Mathematics in English, VDM Verlag Dr. Müller, Saarbrücken, Germany

Willingham, D. (2007). Critical thinking: Why is it so hard to teach? American Educator, Vol. 109, Issue 4, pp. 8–19.

Willis, J. (1996) A Framework for Task-Based Learning, Longman Handbooks for Language Teachers: Longman

Willis, D. & Willis, J. (2001) Task-based language learning, In Carter, R. and D. Nunan (eds), The Cambridge Guide to Teaching English to Speakers of Other Languages. Cambridge: Cambridge University Press.

Willis, D & Willis, J. (2007) Doing task-based Teaching, Oxford: Oxford University Press

Zemelman, S., Daniels, H. & Hyde, A. (1998) Best Practice: New Standards for Teaching and Learning in American's Schools, Portsmouth, NH: Heinemann

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

APPENDIX I - English Monday club year plan

October		
Date	**Activity**	**Aims**
11	- Discussion about the club - Questionnaire Maths in English	-Give students an idea of how the club is going to work. -Highlight students' strengths and weaknesses, likes and dislikes on the topic.
18	- Power Point Presentation - Discussion about the PP presentation.	-Give students the model of the task cycle. -Present students with the importance of group work rules and roles. -Enable students with the language needed for the task.
25	-Task – problem-solving activity (How many outfits? – combinations) - worksheet (groups of three)	- Allow students to discuss to interpret, infer, analyse and discuss the topic.
November		
8	-Preparation of a poster.	- Allow students to organize a poster -Allow students to prepare an oral presentation of the poster. - Enable students with language needed.
15	-Oral presentations - Self-assessment grid	- Give students an opportunity to orally present their line of thought. - Present students with different ways of finding the same answer. - Allow students to reflect upon work done on the last few sessions. - Present students with a model for self-assessment
22	-Peer-assessment - Language focus - Worksheet	- Allow students to reflect upon their peer's attitudes and participation during the cycle. - Focus on expressions used on the presentations
29	-Little Red Riding Hood story – PP presentation. - Problem-solving activity (How to cross the river?)	-Allow students to discuss to interpret, infer, analyse and discuss the topic.
December		
6	-Preparation of a poster.	- Allow students to organize a poster -Allow students to prepare an oral presentation of the poster. - Enable students with language needed.
13	-Oral presentations - Self-assessment grid	- Give students an opportunity to orally present their line of thought. - Present students with different ways of finding the same answer. - Allow students to reflect upon work done on the last few sessions. - Present students with a model for self-assessment

3	- Earth Day! Hooray! - Power Point presentation - Discussion about the story - Problem solving activity - counting	- Give students vocabulary concerning counting and grouping. - Allow students to discuss to interpret, infer, analyse and discuss the topic.
10	- Preparation of a poster	- Allow students to organize a poster -Allow students to prepare an oral presentation of the poster. - Enable students with language needed
17	-Continuation	
24	-Oral presentation -Self-assessment grid	- Give students an opportunity to orally present their line of thought. - Present students with different ways of finding the same answer. - Allow students to reflect upon work done on the last few sessions. - Present students with a model for self-assessment
31	-Peer- assessment grid	- Allow students to reflect upon their peer's attitudes and participation during the cycle.
February		
7	- Language focus - Worksheet	- Focus on expressions used on the presentations
14	-Three Little Pigs, One Wolf and Seven Magic Shapes – Power point presentation of the story	-Give learners vocabulary - Geometric shapes and geometric solids
21	-Let's play tangram: a series of mini logic and deductive activities	-Allow students to discuss to interpret, infer, analyse and discuss the topic.
28	-Tangram activity – building the story characters with Tangram	- Allow students to discuss to interpret, infer, analyse and discuss the topic.
March		
14	-Preparation of the report	- Allow students to organize a poster -Allow students to prepare an oral presentation of the poster. - Enable students with language needed
21	-Oral presentation -Self-assessment grid	- Give students an opportunity to orally present their line of thought. - Present students with different ways of finding the same answer. - Allow students to reflect upon work done on the last few sessions. - Present students with a model for self-assessment
28	-Peer-assessment	- Allow students to reflect upon their peer's attitudes and participation during the cycle.
April		
4	-- Language focus - Worksheet	- Focus on expressions used on the presentations

May		
2	-Mid-term assessment	-Elicit data about how the learners are dealing with the level of difficulty, vocabulary . -Elicit data about group work. -Elicit data about learners perception of the teaching cycle.
9	-Sherlock Holmes comes to the Maths Club – Power Point presentation of the story	-Allow students to discuss to interpret, infer, analyse and discuss the topic.
16	-Problem-solving activity – Who kidnapped Miss Sally	-Allow students to discuss to interpret, infer, analyse and discuss the topic.
23	-Preparation of the report	- Allow students to organize a poster -Allow students to prepare an oral presentation of the poster. - Enable students with language needed
30	-Oral Presentation -Self-assessment grid	- Give students an opportunity to orally present their line of thought. - Present students with different ways of finding the same answer. - Allow students to reflect upon work done on the last few sessions. - Present students with a model for self-assessment
June		
6	-Peer-assessment -- Language focus - Worksheet	- Allow students to reflect upon their peer's attitudes and participation during the cycle. - Focus on expressions used on the presentations
20	-End of term assessment	-To gather relevant data for future analysis, regarding Mathematical reasoning; -To give learners feedback on their progress in mathematical thinking

APPENDIX II – Data collection table

Techniques	Description of the technique	Time /Teaching Cycle	Objectives
Self-assessment (learners' worksheet)	At the end of each cycle, learner, individually, would fill in a worksheet about what they believe their performance was during the cycle. They would have to tick the level of commitment for each criteria. The levels would go from *inadequate; barely adequate; adequate; good; very good; excellent*. The criteria was concerned with learners' participation in the task cycle; spoken expression; critical thinking ability; group work skills; group work role; and the report. (Appendix III)	At the end of each teaching cycle	☞ To allow learners to have a reflective moment to analyse their own performance during the cycles. ☞ To give the learners simple, clear and structured information on what the teacher expects from them, allowing learners to begin to take control of their own learning process. ☞ To allow learners to develop their critical faculties. ☞ To engage learners in autonomous learning. ☞ To motivate learners to take greater responsibility in their performance. ☞ To develop the learner's sense of fairness
Peer-assessment (learners' worksheet)	The peer-assessment worksheet is quite similar to the self-assessment worksheet, using the same levels and criteria. However, in this assessment worksheet, learners would write their peers' names in each criteria according to their level of commitment during the cycle. Once again, this assessment was done at the end of each cycle. (Appendix IV)	At the end of each teaching cycle	☞ To allow learners to have a reflective moment to analyse their peers' performances during the cycles. ☞ To allow learners to develop their critical faculties. ☞ To engage learners in autonomous learning. ☞ To motivate learners to take greater responsibility in their performance ☞ To develop leadership skills ☞ To allow the learner to be assessed by multiple assessors, broadening their perspective of their learning process. ☞ To develop the learner's sense of fairness
Questionnaires	Throughout the whole year, learners answered two questionnaires. Each questionnaire was designed using closed-response questions about learners' opinions on the level of difficulty in language and Mathematics; each task cycle; assessment tasks; and group work. (Appendix V and VI)	1^{st} – beginning of October 2^{nd} – beginning of May	☞ To elicit data from learners about how they feel about language level of difficulty ☞ To elicit data from learners about the level of difficulty in the problem-solving activities. ☞ To elicit data from learners about their perspective of how helpful cooperative work can be . ☞ To elicit data from learners on general opinion about the teaching cycles.
Report Assessment (Teacher's checklist)	At the end of each task Cycle, learners would present their report of the task. The teacher filled in a checklist (Appendix VII) regarding several aspects of the report. Some aspects regarding the whole group (poster presentation, overall structure of the presentation, overall language use, finding the correct answer for the problem-solving activity), other aspects were only concerned with individual performance (spoken English language, mathematical terminologies; overall commitment to the presentation) The marks given were based on CEFR levels.	At the end of each Report presentation	☞ To gather relevant data relevant future analysis, regarding: • Language; • Cooperative work; • Mathematical reasoning; ☞ To give learners feedback on their progress in language and mathematical thinking

Observation (video recording)	In the penultimate teaching cycle, a video recording was made on the following parts of the Cycle: *task; planning; and report.*	During the fourth teaching cycle	☞ To gather relevant data for future analysis, regarding: • Language; • Cooperative work; • Mathematical reasoning;
Field-notes - Real time observation (note taking)	As learners had some moments of group work, I was able to keep a written diary which included personal records of the learners' use of language, group work commitment and individual learner's weaknesses and strengths.		☞ To gather relevant data for future analysis, regarding: • Language; • Cooperative work; • Mathematical reasoning;
End-of-term assessment	At the end of the term, learners did a small test that included several testing techniques such as, matching, filling in gaps, labelling, multiple choice and a very small logic and deductive problem-solving activity. This test incorporated all mathematical items that had been developed during the year. (Appendix VIII)	At the end of the fifth teaching cycle	☞ To gather relevant data for future analysis, regarding Mathematical reasoning; ☞ To give learners feedback on their progress in mathematical thinking.

Assessment criteria grid – self-assessment

Activity:_____

Name:_____

Criteria	Inadequate	Barely Adequate	Adequate	Good	Very good	Excellent
Participation: I participated in the activity with interest and enthusiasm.						
Spoken expression: I can expresses myself clearly and coherently.						
Critical thinking skills I can interpret, analyse, explain and discuss the problem and I am able to find the correct answer.						
Group work skills: I pay attention when my peers are expressing their ideas.						
I made sure everyone spoke.						
I was encouraging towards my peers.						
I respected everyone's opinion.						
Group work role: I can play my role.						
Presentation: I can organise a clear presentation .						
I can orally explain my line of thought.						

APPENDIX IV – Peer-assessment grid

Assessment criteria grid - Peer assessment

Activity: ______________________

Name : ______________________

Criteria	Inadequate	Barely Adequate	Adequate	Good	Very good	Excellent
Participation: Participates enthusiastically in the discussion.						
Spoken expression: Expresses themselves clearly and coherently.						
Quality of thought: Analyses the problem well. Gets to the root of the problem.						
Group work skills: Paid attention when the members of the group were expressing their ideas						
Made sure everyone spoke.						
Was encouraging towards members of the group.						
Respected everyone's opinion						
Group work role: Played their role.						
Presentation: Participated on the preparation of the oral presentation.						

APPENDIX V – First questionnaire for the English Club

Maths in English

Queen Elizabeth's School

Name:_____ Age:____ F M

Date:____ - ____ - ____

We are now entering a new realm " Maths in English". In order for me to understand what you like, what you find easy or difficult or even what activities you like the most, here's some questions about English and Maths.

Remember: There are no "right" or "wrong" answers, this is not a test.

Instructions: For each question tick (✓) only **one** option.

1. English is a useful language to learn.
   ☐☺ ☐ ☹ ☐☹
2. I like learning English.
   ☐☺ ☐ ☹ ☐☹
3. I like learning other subjects in English.
   ☐☺ ☐ ☹ ☐☹
4. I like Maths.
   ☐☺ ☐ ☹ ☐☹
5. I like learning Maths in English .
   ☐☺ ☐ ☹ ☐☹
6. I like doing Maths activities in English.
   ☐☺ ☐ ☹ ☐☹

Instructions: Place a check mark (**X**) on one of the seven positions, indicating how you feel about the statements. Follow the example.

Eg. Drawing for me is:

difficult ___ : ___ : ___ : ___ : **X** : ___ : ___ easy

1. Reading in English is:

   difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

2. Listening in English is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

3. Speaking in English is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

4. Doing problem-solving activities is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

5. Interpreting the activity's instructions is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

6. Identifying useful information from the instruction is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

7. Explaining how I solved the problem-solving activity is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

Instructions: For each question tick (✓) only **one** option.

	I agree	I disagree
1. Activities in groups are fun.		
2. Everyone is important inside the group.		
3. Every person in the group has a role.		
4. Each role is important for the group to work well.		
5. It is important to listen carefully to other's views.		
6. It is important to respect other's opinions.		

APPENDIX VI – Mid-term assessment

Mid-Term assessment

Name:_____ Age:_____ F☐ M☐

Date: ____ - ____ - _____

Now that you have had opportunity to learn Maths in English, here are some questions about this adventure so far.

A. Instructions: For each question tick (✓) only **one** option.

1. The task cycle is fun (Story – Task – Presentation – Language focus- Assessment).

☺ ☐ 😐 ☐ ☹ ☐

2. I enjoy listening to stories with problem-solving activities, in English.

☺ ☐ 😐 ☐ ☹ ☐

3. I enjoy doing problem-solving activities, in English.

☺ ☐ 😐 ☐ ☹ ☐

4. I enjoy doing oral presentations, in English.

☺ ☐ 😐 ☐ ☹ ☐

5. I enjoy doing the Language Focus activities.

☺ ☐ 😐 ☐ ☹ ☐

6. I enjoy doing the assessment worksheet.

☺ ☐ 😐 ☐ ☹ ☐

Instructions: Place a check mark (X) on one of the seven positions, indicating how you feel about the statements. Follow the example.

Eg. Drawing for me is:

difficult ___ : ___ : ___ : ___ : X : ___ : ___ easy

1. Reading in English is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

2. Listening in English is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

3. Speaking in English is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

4. Doing problem-solving activities is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

5. Interpreting the activity's instructions is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

6. Identifying useful information from the instruction is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

7. Explaining how I solved the problem-solving activity is:

difficult ___ : ___ : ___ : ___ : ___ : ___ : ___ easy

Instructions: For each question tick (✓) only **one** option.

	I agree	I disagree
1. Activities in groups are fun.		
2. Everyone is important inside the group.		
3. Every person in the group has a role.		
4. Each role is important for the group to work well.		
5. It is important to listen carefully to other's views.		
6. It is important to respect other's opinions.		

Thank you!

Group Marks

Groups names / Criteria of Assessment	Super Stars	Math's Kids	The Mathematics	Math Kids, The Fantastic	FranRakGuedes	Math's Group
Overall Poster Presentation						
Structure of the Presentation						
Overall Language use						
Finding the correct answer for the problem						
Mathematical reasoning						
Retelling of the story						

Individual Marks

Names / Criteria	Super Stars			Math's Kids			The Mathematics			Math's Kids, The Fantastic				FranRakGuedes			Math's Group		
	Ana	Afonso	Ana L.	Duarte	Beatriz	João C.	Stela	Matilde	Leonor	Marta	Maria	João M.	Inês	Francesco	Raquel	Guedes	Vera	João B.	Iñaki
Language use																			
Commitment to group work																			
Mathematic terminology																			

Marks:

A – Excellent

B – Very Good

C – Good

D – Needs Improvement

APPENDIX VIII – End of term assessment

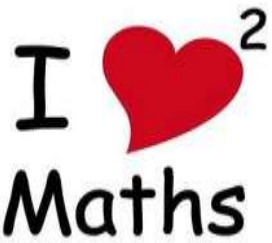
Mid-term assessment

name:_____

date:___ - ___ - ____

1. Match.

1st ♦	♦tenth
2nd ♦	♦eighth
3rd♦	♦ninth
4th ♦	♦fifth
5th♦	♦fourth
6th♦	♦third
7th ♦	♦ second
8th ♦	♦ first
9th♦	♦ seventh
10th♦	♦ sixth



2. Match

10♦	♦ one hundred
100♦	♦ ten
1000♦	♦one thousand
16♦	♦sixteen
134♦	♦one thousand, two hundred and seventeen
1217♦	♦one hundred and thirty four

3. Write the correct word under each symbol. There's and extra word.

times minus

plus number

equals

x **-** **+** **=**

_____ _____ _____ _____

4. Which operation is this?

multiplication division

addition subtraction

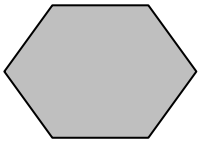
Write the correct word under each operation.

23 + 12 = 45 x 1 = 45: 2 = 21-13=

_____ _____ _____ _____

5. **Look at the geometric shapes. Write their names. There's an extra word.**

_____

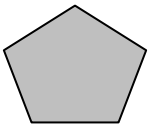


_____

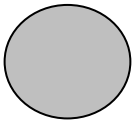
triangle circle square

rectangle hexagon pentagon

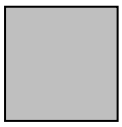
parallelogram losange



_____

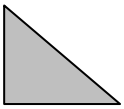


_____



_____

_____



_____

6. **Think and answer.**

a) Type the missing number in this sequence:

1, 3, 9, 27, 81, ____

b) There are 6 chairs in the first row, 9 chairs in the second row, 12 chairs in the third row, 15 chairs in the fourth row, and 18 chairs in the fifth row. If this pattern continues, how many chairs will there be in the sixth row?

- 24
- 22
- 20
- 21

c) The city hall is not shorter than the art museum. The shopping mall is shorter than the art museum. Which building is the shortest?

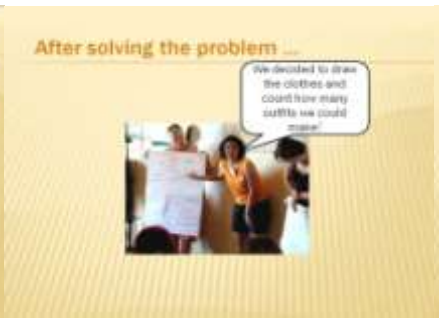
- the shopping mall
- the city hall
- the art museum

Teaching Cycle Table

Teaching Cycle	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Pre- Task: Story Synopses	**A Maths Lesson** This is the story about three boys (Henry, Simon and David) aged 10 who are in a Maths lesson. The teacher asks them to try and solve a problem and them present a report to the rest of the class. The class is divided into groups of threes and the three boys are in the same group work. As they try to do the task, they fail because they are unable to agree on the reasoning for the problem. When the time comes to present the report, they haven't solve the problem and fail to present a report. (Appendix X)	**The Little Red Riding Hood** The pre-task is a play students attended to. It is the story of Little Red Riding hood (adapted from the original story). What differs this story from original is the number of new characters like an Ogre, Flowers and animals from the Forest.	**Earth Day Hooray!** This is the story of a group of children that realise that the park that surrounds their school is very dirty and they plan some activities to collect all the garbage from the park, mainly cans. Their plan is to exchange the cans for money and use that money to buy flowers to plant in the park. (Appendix XII)	**Three Little Pigs and the Seven Magic Shapes** This story is parallel to the original story, only these three pigs leave their family to seek their fortunes. Each of them went their separate way and meet different animals in the forest. Each animal gives each pig seven magic shapes (Tangram) to use wisely so they can find their fortune. Meanwhile, Big Brad Wolf, twin brother of Big Bad Wolf from the original story, tries to eat the three little pigs. At the end, only the sister pig survives and marries the little pig from the original story and they live happily ever after. (Appendix XIII)	**Sherlock Holmes comes to the Math's Club** This is a mystery story. Miss Sally, Math's teacher, was kidnapped and Sherlock Holmes was called to solve this mystery. With the help of the students, Sherlock Holmes discovers that Miss Sally was kidnapped by a well know mathematician, professor Moriarty. Miss Sally was saved and professor Moriarty went to jail. (Appendix XIV)
Task Cycle: TBL problem-solving Task	**Combinations:** Learners had to combine t-shirts of different colours with trousers of different colours and one blue skirt.(Appendix XI)	This problem solving activity was divided into two activities. One near the end of the story and the other at the end of the story. **Code breakers:** At some point, Little Red Riding Hood, two friends (a flower and an Ogre) and Grandma's basket of food, need to cross a river, but to do so they have to open a chest that has a valuable message inside that will help them cross the river. Students, in groups, need to break the code and read the message. **How to cross the river:** Little Red Riding Hood and her friends need to cross the river so she can get away from the wolf. Students need to follow a few rules (the message inside the chest) so they can cross the river a go to Grandma's house.	**How many cans have we got?** Throughout the story, a group of four children desperately want to clean the park surrounding their school. To be able to exchange the cans for a good amount of flowers to plant, they need to gather 5.000 cans so they can go to the recycling centre and receive the money to buy flowers. In groups, students have to pay attention to all the bags of cans filled in by the children from the story. It can be bags of tens, hundreds and thousands. Each group need to find out whether they were able to get 5.000 cans or not.	**Let's play Tangram!** In groups, students had to first earn all the seven magic shapes by doing very quick and easy logic/deductive mini activities When they had earned all seven shapes (Tangram), they were asked to make one of the characters of the story, solely by looking at the character's shade.	**Who Kidnapped Miss Sally?** In groups, students have to uncover three mysteries using their logic and deductive skills. While listening the beginning of the story very carefully, in groups, students have to find out the correct names of the three eye witnesses to the kidnapping. By analysing a serious of robberies, they need to find the pattern and find out where the next robbery is going to take place so as to find out who kidnapped Miss Sally. When the guilty one is in prison, he likes to spend his time playing with cards. He dealt six cards face down on the table. In groups and by following only four clues, students have to organise the cards in the same order as Professor Moriarty. (Appendix XV)

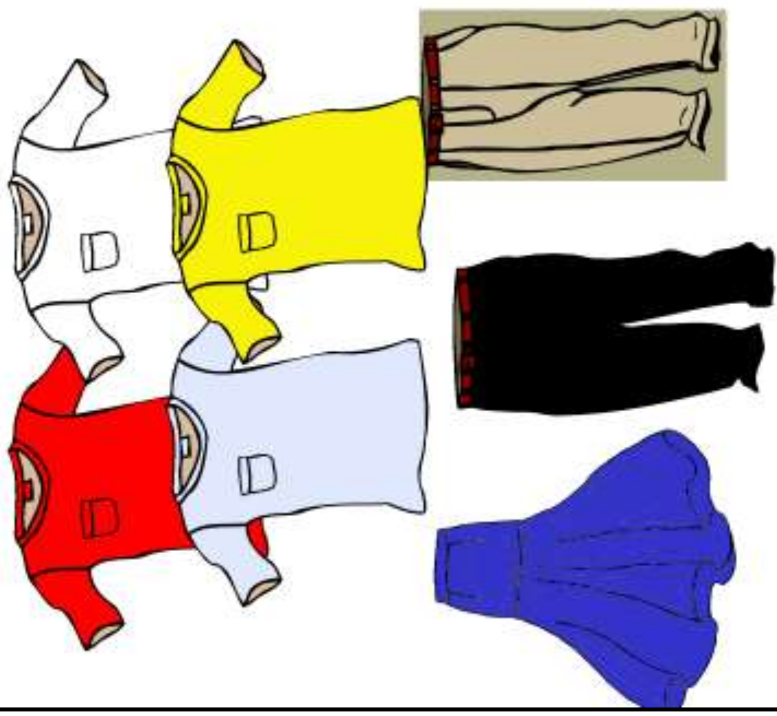
Planning	Students prepare a report to present for the whole class (written). The explain how they did the task and what conclusions they have come up with.	Students prepare a report to present for the whole class (oral). The explain how they did the task and what conclusions they have come up with. (Code breakers activity is automatically corrected. It was the pre-task of the main task. It was used to keep learners engaged in the story and problem-solving activity.)	Students prepare a report to present for the whole class (oral). The explain how they did the task and what conclusions they have come up with.	Students prepare a report to present for the whole class (oral). The explain how they did the task and what conclusions they have come up with.	Students prepare a report to present for the whole class (oral). The explain how they did the task and what conclusions they have come up with.
Report	Each group came to the board and presented their poster and their conclusions, explaining how they came to the conclusion of the number of outfits	Each group came to the board and with the help of mini figures of the characters of the story, they present and explain every step they took so that they could all safely cross the river.	Each group comes to the board and retells the story giving the correct amount of cans the children were able to gather and answering the ultimate question "Where they able to get the 5.000 cans and buy flowers to plant?"	Each group came to the board, retold the story and explained how they positioned each magic shape in order to build the character.	In groups, students presented an oral presentation where they retell the story and give the correct answer for each mystery by explaining they mathematical reasoning.
Group work dynamics (Task Cycle)	5 groups of three students and one group of four students	5 groups of three students and one group of four students	5 groups of three students and one group of four students	5 groups of three students and one group of four students	5 groups of three students and one group of four students
Level of difficulty	Extremely easy	Quite Easy	Easy	Difficult	Very Difficult
Language Focus: Mathematical Language	♦ understand the meaning of diagrams, mathematical drawings, names of the four mathematical operations.	♦ cardinal numbers and mathematical operations	♦ cardinal numbers, grouping numbers (tens, hundreds, thousands), mathematical operations.	♦ Geometric shapes.	♦ No new mathematical language
English Language	Language required for a presentation: ☞introduction of the group; ☞Sequencing actions: *first we, Next we; then we ...* ☞ Conclusion of the presentation: *we came to the conclusion that; the answer is ...*	☞Can and can't	☞sequencing a story (matching) ☞How many?	☞ Patterns of comparison (taller than; smaller than; has more than; heavier than; fewer than; older than; highest; smallest and fewest)	☞ Names of cards ☞prepositions of place: between, on the left, on the right, in front of, next.
Mathematical Skills	✓ Logic ✓Deduction	✓ Logic ✓Deduction	✓ Logic ✓Deduction	✓ Logic ✓Deduction	✓ Logic ✓Deduction
Critical Thinking Skills	☺ Interpretation ☺ Analysis ☺inference ☺explanation	☺ Interpretation ☺ Analysis ☺inference ☺explanation	☺ Interpretation ☺ Observation ☺ Analysis ☺inference ☺explanation	☺ Interpretation ☺ Analysis ☺inference ☺explanation	☺ Interpretation ☺ Analysis ☺inference ☺explanation

APPENDIS X – The story - A Math's Lesson



APPENDIX XI - Problem-solving activity – What can I wear?

What can I wear?



I have 4 shirts one is red, one yellow, one white, and one blue. I have 2 pairs of pants that are black and khaki and one skirt that is dark blue. I can wear all these with all 4 shirts. How many different outfits do I have?

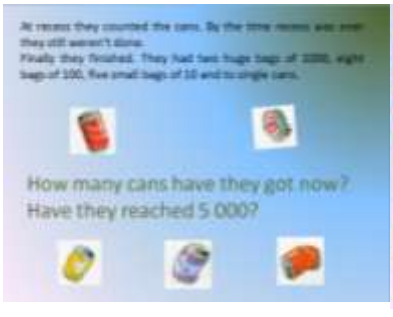
Use this space to help you solve the problem.

Name of the group:________________

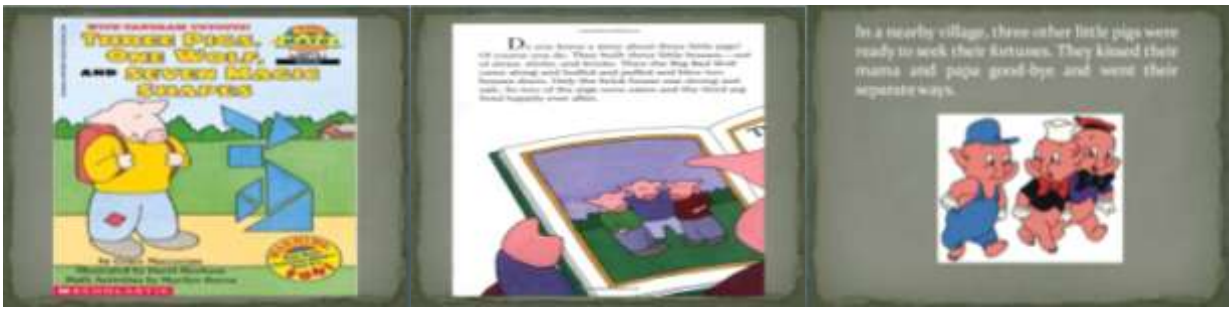
Date: ___ - ___ - ___

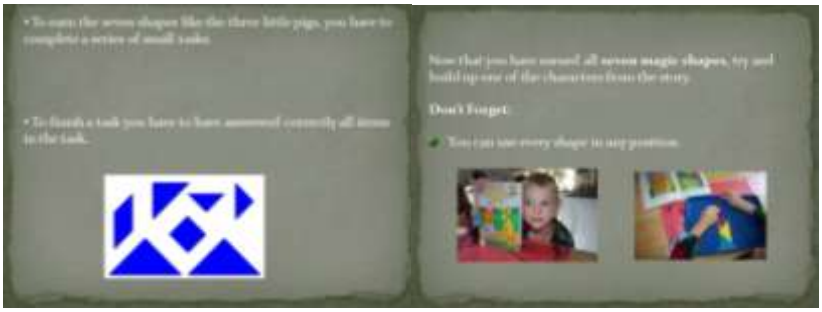
Answer:____________________

APPENDIX II – The story - Earth-Day - Hooray!

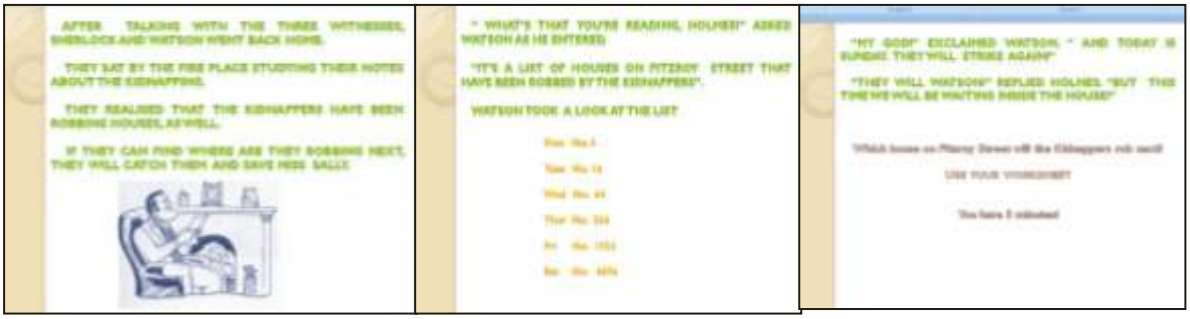


APPENDIX XII – The story - Three Little Pigs and the Seven Magic Shapes





APPENDIX XIV – The story - Sherlock Holmes came to the Math's Club



APPENDIX XV – Worksheet for the problem-solving activity "Sherlock Holmes came to the Math's Club"

Sherlock Holmes came to the Math's Club

A - What's the name of the witnesses?

First names:

_____ _____ _____

Surnames:

_____ _____ _____

Clues:

None of the men's first name matched their surname;

Mrs Richards first name is Andrew.

Can you help Sherlock and find the full name of all three witnesses?

1st witness - _____

2nd witness - _____

3rd witness - _____

B – Which house will they rob next?

Sunday No. _____

Clues:

Mon No. 4 Tues No. 16

Wed No. 64 Thur No. 256

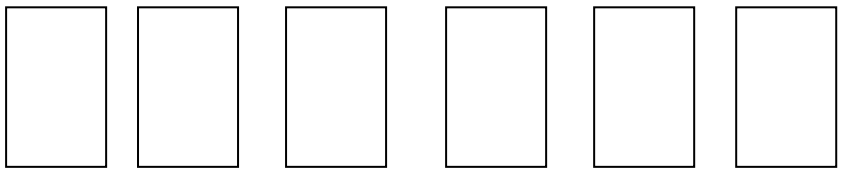
Fri No. 1024 Sat No. 4096

C- Why do you think Professor Moriarty kidnapped Miss Sally?

_____

_____

D – What is the sequence of the six cards. Draw them and write their names.



_____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

APPENDIX XVI – Language focus worksheet (first teaching cycle)

Language Focus

Name:_____

Date:_____

1. Here's a transcript of a presentation from a group of students. **Fill in the gaps.**

"Good afternoon,

We are going to present our conclusions.

The _____ of the problem was _____.

We decided to _____. We made _____ diagrams.

_____, we have the black pants on the center. So the black pants _____ the blue shirt, the yellow shirt, the white shirt and the blue shirt.

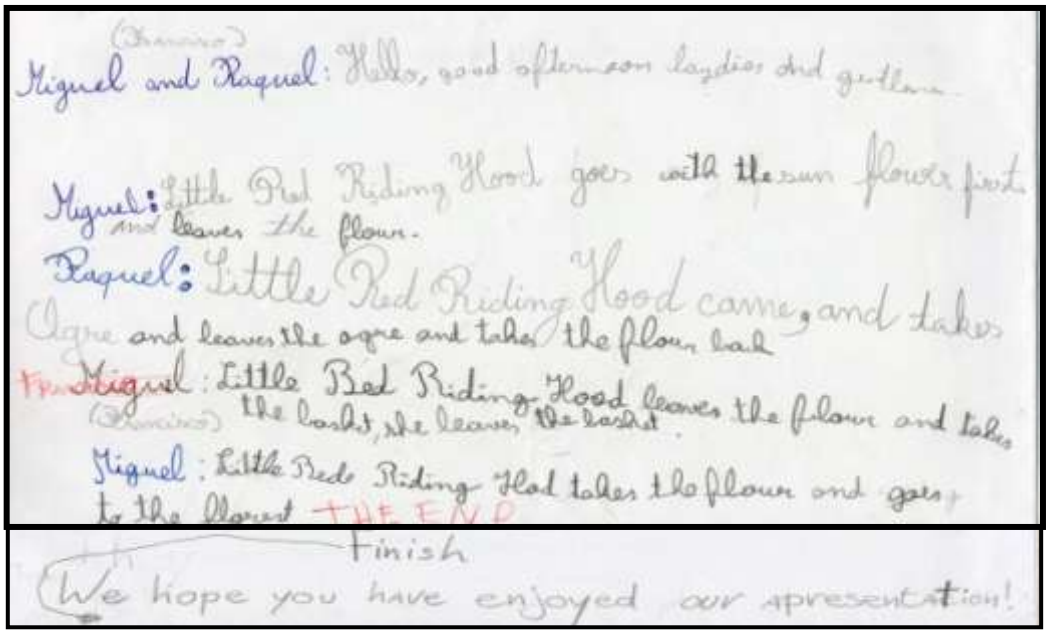
_____, we have the khaki pants on the center. So, the khaki pants _____ the blue shirt, the yellow shirt, the white shirt and the blue shirt.

_____, we have the blue skirt on the center. So, blue skirt _____ the blue shirt, the yellow shirt, the white shirt and the blue shirt.

Then, we _____ the number of outfits we could have and we _____ that we can have _____ outfits."

question	draw diagrams	three	how many outfits we can have
On the first diagram	goes with	counted	
On the next diagram	came to the conclusion	On the last diagram	
goes with		goes with	

APPENDIX XVII – Learners' texts for their oral presentation (Teaching cycle two)



Miguel and Raquel: Hello, good afternoon ladies and gentlemen

Miguel: Little Red Riding Hood goes with the sun flower first and leaves the flour.

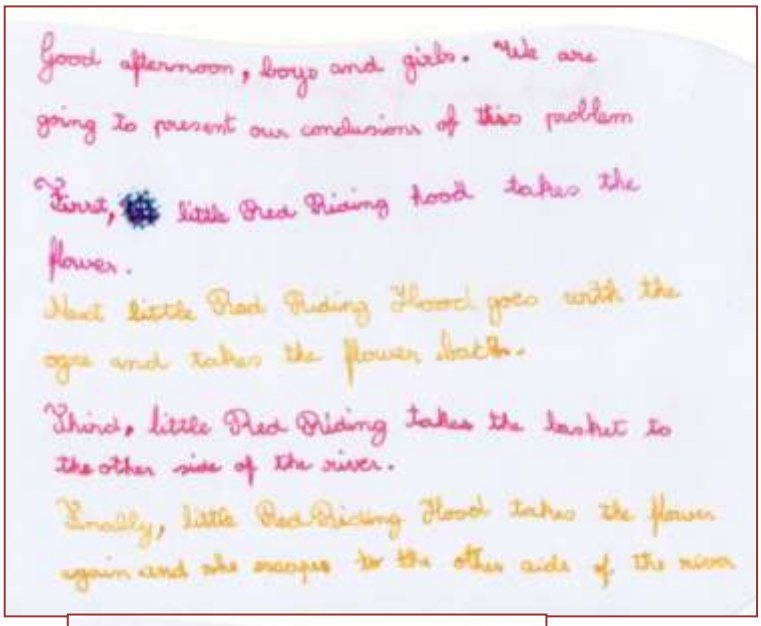
Raquel: Little Red Riding Hood came, and takes Ogre and leaves the ogre and takes the flour back

Miguel: Little Red Riding Hood leaves the flour and takes the basket, she leaves the basket.

Miguel: Little Red Riding Hood takes the flour and goes to the Planet THE END

Finish

We hope you have enjoyed our apresentation!



Good afternoon, boys and girls. We are going to present our conclusions of the problem

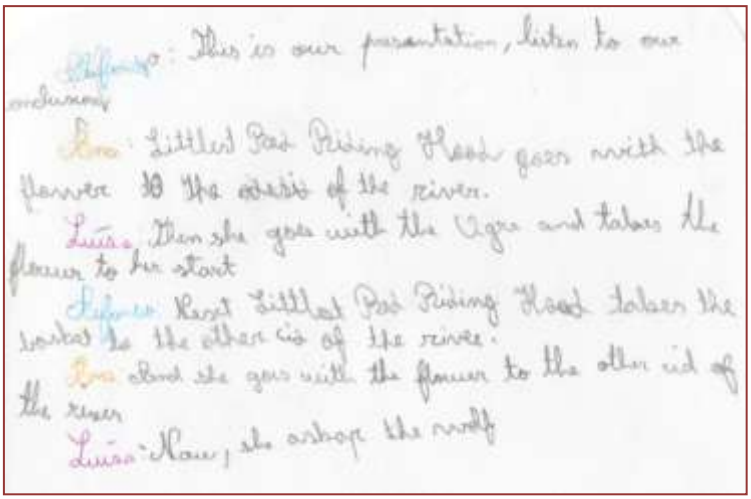
First, Little Red Riding Hood takes the flower.

Next Little Red Riding Hood goes with the ogre and takes the flower back.

Third, Little Red Riding takes the basket to the other side of the river.

Finally, Little Red Riding Hood takes the flower again and she escapes to the other side of the river

Thank you, for your attention.



This is our presentation, listen to our conclusions

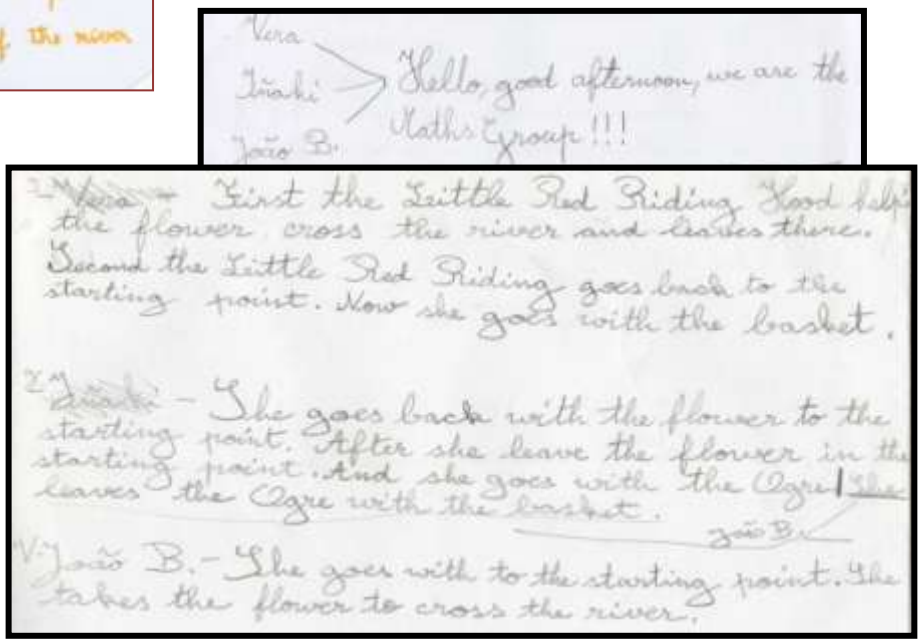
Vera: Little Red Riding Hood goes with the flower to the other side of the river.

Luisa: Then she goes with the Ogre and takes the flower to her start

Next Little Red Riding Hood takes the basket to the other side of the river.

And she goes with the flower to the other side of the river

Now, she escape the wolf



Vera
Iriaki
João B.

Hello, good afternoon, we are the Maths Group !!!

Vera - First the Little Red Riding Hood helps the flower cross the river and leaves there. Second the Little Red Riding goes back to the starting point. Now she goes with the basket.

Iriaki - She goes back with the flower to the starting point. After she leave the flower in the starting point. And she goes with the Ogre. She leaves the Ogre with the basket.

João B.

João B. - She goes with to the starting point. She takes the flower to cross the river.

APPENDIX XVIII - Audio transcript for the last teaching cycle task.

First mini task – Matching names to surnames:

S1- Raquel

S2 – Miguel

S3 – Francisco

S2 – Então we have Mr. Frank Mr. Richards and Mr. Andrews for last name

S1- And Andrew, Frank and Richard for first name né? Where are the clues?

S3 - Here. Eu read ok? None of the men's first name matched their surnames. O que é surnames?

S1- É last names, apelidos, vá….

S3 – Mrs Richards first name is Andrew.

S2 – Raquel escreve lá essa.

S1 – English Miguel, a miss está a gravar….

S2 - Raquel write Mr. Andrew Richards.

S1 – Easy….. So Mr. Frank is Andrews and Mr. Richards is Frank…

S2 – Yes! Understand Francisco?

S3 - Yes….

S1 – There only two left it is trocar names, understand?

S3 – Yes….

Second mini-task – Find out which house will be robbed next.

S3 – Fácil…. é vezes quarto.

S1 – Francisco in english…..

S3 – não sei dizer…

S1 – It is the number times four, não é miss, é times vezes?

Teacher – Yes, it is. Well done.

S2 – So 4096 time four is… do it in paper…

S1 – 16 384…. Miguel do the count again to be….to be…

Teacher – Sure?

S1 - Sim, to be sure.

S2 – Ok… it's correct.

S1, S2, S3 – Miss we finished

Third mini-task – Find out why professor Moriarty kidnapped Miss Sally.

S2 – Well…. She is a Math teacher and he is Math teacher…

S3 – E? O que tem?

S1 – Yes, talvez she know something about Math

S2 - Yes, something important , secret

S3 – Escreve isso…

S1 – Calm Francisco…. Ok… So Professor Moriarty kidnapped Miss sally because….

S2 – She have a secret …. a Math secret…

S3 – ya!

Fourth task - find out the sequencing of six cards according to four rules.

S1 – Ok…Miguel put the cards on the table…Let's see…

S2 – Francisco read the rules…

S3 – The King of spades had the Ace of Hearts and the Ace of Diamonds to its left.

S2 – Let's put the King in the middle and the Aces on left.

S1 – Yes and which one is first? This or this? (pointing to the Aces)

S2 – Francisco read the rules maybe we find…

S3 – The Queen of Dimonds had the Ten of Clubs to its right.

S1 – Miguel put them there….

S2 – Who?

S1 – The Queen and the Ten…

S2 – Ok

S3 – Posso?...The queen of hearts is separated from the spade by two cards…

S1 – Maybe it's the Queen, the Ten, something and the King, there's two cards….

S2 – Yes, but what comes after the Ten….

S3 – Look…. última …. Three cards separate the two Hearts.

S1 – Ah?!

S2 – Wait…. Let's see…. Queen of diamonds, Ten, Queen of Hearts…

S1 – No… The Queen of Diamonds had the Ten in its right….

S3 – Queen Hearts, Ten, Queen de ouros e King…

S1 - Boa! Hmm… Good Francisco….

S2 – So we have two Ace…..How?

S1 – Three cards separate the Hearts…. so the Ace of Hearts comes first the Ace of Diamonds. Né?

S2 – Nice!

S1, S2, S3 - We finish…

Oral presentation - Report

S1, S2 and S3 - Hello everybody, We are going to present our conclusions.

S1- For the first task the answer is Mr. Richard Andrews, Mr. Frank Richards and Mr. Andrew Frank

S3 – Next the task. We discovered that the next house is sixteen hundred and…. no…. sixteen thousand and three hundred and eight four…

S2 – The third task the answer is, Professor Moriarty kidnapped Miss Sally because she has a Math secret….

S1 – We found the sequence of the cards with the rules.

S2 – First the Queen of Hearts

S1 – Then the Ten of Clubs.

S3 – Then the Queen of Diamonds

S2 – Then the King of Spades

S1 – Then the Ace of Hearts

S3 – And last the Ace of Diamonds

S1, S2, and S3 – This is our conclusion, hope you like it. Goodbye.

APPENDIX XIX - Core Critical Thinking skills and Subskills cited from APA Report: Expert consensus on Critical Thinking - adapted from Facione's table, 2011.

Core Critical Thinking Skills		
Skill	**Experts' Consensus Description**	**Subskill**
Interpretation	" To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria."	Categorise Decode Significance Clarify meaning
Analysis	"To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other terms of representation intended to express belief, judgment, experiences, reasons, information or opinions."	Examine ideas Identify arguments Identify reasons and claims
Inference	"To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypothesis; to consider relevant information and to educe the consequences from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation."	Query evidence Conjecture alternatives Draw conclusions using inductive and deductive reasoning
Evaluation	"To assess the credibility of statements or other representations that are accounted or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, or other forms of representation."	Assess credibility of claims Assess quality of arguments that were made using inductive and deductive reasoning
Explanation	"To state and to justify that reasoning in terms of the evidential conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments."	State results Justify procedures Present arguments
Self-Regulation	"Self-consciously to monitor one's cognitive activities, the elements used in those activities and the results educed particularly by applying skills in analysis and evaluation to one's own inferential judgments with a view toward questioning, conforming, validating, or correcting either one's reasoning or one's results."	Self-monitor Self-correct

(Adapted from Facione's Table, 2011)